PROJECT MANUAL

VIRGINIA DEPARTMENT OF TRANSPORTATION: NEW KENT SAFETY REST AREA & INFORMATION CENTER

PROJECT CODE: 501-06501-005
IFB – 743-RD

VOLUME 1 OF 2

DJG, INC.
449 MCLAWS CIRCLE
WILLIAMSBURG, VIRGINIA 23185

DJG COMMISSION NO: 2070030

DATE: AUGUST 3, 2006

VIRGINIA DEPARTMENT OF TRANSPORTATION
NEW KENT SAFETY REST AREA
& INFORMATION CENTER
PC: 501-06501-005

TABLE OF CONTENTS

BIDDING INFORMATION	**Form Number**
Invitation for Bids	
Instructions to Bidders	DGS-30-055
Prebid Question Form	DGS-30-272
Standard Bid Bond	DGS-30-090

GENERAL CONDITIONS AND FORMS

DGS forms can be viewed or downloaded at the DGS Form Center at http://forms.dgs.virginia.gov

General Conditions of the Construction Contract	DGS-30-054
Supplemental General Conditions	DGS-30-377
VDOT Supplement to the General Conditions of the Construction Contract	AS-42
Contract Between Owner and Contractor	DGS-30-064
Workers Compensation Certification of Coverage	DGS-30-076
Standard Performance Bond	DGS-30-084
Standard Labor and Material Payment Bond	DGS-30-088
Contract Change Order	DGS-30-092
Schedule of Values and Certificate for Payment	DGS-30-104
Affidavit of Payment of Claims	DGS-30-108
Architect/Engineers Certificate of Completion	DGS-30-112
Architect/Engineers Certificate of Substantial Completion	DGS-30-116
Final Report of Structural Special Inspections	DGS-30-120
Certificate of Completion by Contractor	DGS-30-136
Certificate of Partial or Substantial Completion by Contractor	DGS-30-140
Sample Submittal Register	DGS-30-364
Opinion of A/E Performance (Construction Phase)	DGS-30-160
Opinion of Contractor Performance	DGS-30-164
Construction Risk Allocation	
Early Completion Incentive and Release of All Claims Certification Form	
VDOT Special Provision For Stormwater Pollution Prevention Plan	S107F1B-0105
VDOT SWPP Plan Contractor and Subcontractor Certification Statement	S107G0B-1103
VDOT Construction Runoff Control Inspection Form	C107
VDOT SWAM Business Plan	

TECHNICAL SPECIFICATIONS

Technical Specifications Table of Contents follow this page

PROJECT TABLE OF CONTENTS

DOCUMENTS 00 - INTRODUCTORY, BIDDING, AND CONTRACT REQUIREMENTS

00870 DESIGN SELECTION SUMMARY

DIVISION 01 - GENERAL REQUIREMENTS

01039 COORDINATION AND MEETINGS
01110 SUMMARY OF WORK
01150 LEED GREEN BUILDING SUMMARY, REQUIREMENTS AND GOALS
01300 SUBMITTAL PROCEDURES
01400 QUALITY CONTROL
01450 INDOOR AIR QUALITY MANAGEMENT
01500 TEMPORARY CONSTRUCTION FACILITIES
01550 CONSTRUCTION WASTE MANAGEMENT
01590 FIELD OFFICES AND SHEDS
01600 PRODUCT REQUIREMENTS
01700 CLOSEOUT PROCEDURES
01781 OPERATION AND MAINTENANCE DATA
01810 GENERAL COMMISSIONING REQUIREMENTS
01815 HVAC COMMISSIONING REQUIREMENTS
01820 DEMONSTRATION AND TRAINING

DIVISION 02 - SITE CONSTRUCTION

02100 ASBESTOS REMOVAL IN OCCUPIED BUILDINGS NEW KENT REST AREA COMPLEX
02231 CLEARING AND GRUBBING
02315 EXCAVATION, FILLING, AND BACKFILLING
02360 SOIL TREATMENT FOR SUBTERRANEAN TERMITE CONTROL
02510 WATER DISTRIBUTION
02531 SANITARY SEWERS
02630 STORM DRAINAGE
02631 CISTERN
02761 PAVEMENT MARKINGS
02770 CONCRETE SIDEWALKS AND CURBS AND GUTTERS
02870 SITE FURNISHINGS
02921 SEEDING
02930 EXTERIOR PLANTS
02935 LANDSCAPE ESTABLISHMENT

DIVISION 03 - CONCRETE

03200 CONCRETE REINFORCEMENT
03300 CAST-IN-PLACE STRUCTURAL CONCRETE

DIVISION 04 - MASONRY

04200 MASONRY

DIVISION 05 - METALS

05120 STRUCTURAL STEEL

DIVISION 06 - WOOD AND PLASTICS

06100 ROUGH CARPENTRY
06193 METAL PLATE CONNECTED WOOD TRUSSES
06200 FINISH CARPENTRY
06410 LAMINATE CLAD ARCHITECTURAL CASEWORK
06650 SOLID POLYMER (SOLID SURFACING) FABRICATIONS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07112 BITUMINOUS DAMPPROOFING
07212 MINERAL FIBER BLANKET INSULATION
07213 NATURAL COTTON THERMAL BLANKET INSULATION
07310 SYNTHETIC SLATE ROOFING
07625 COPPER SHEET METAL FLASHING
07920 JOINT SEALANTS

DIVISION 08 - DOORS AND WINDOWS

08110 STEEL DOORS AND FRAMES
08120 ALUMINUM DOORS AND FRAMES
08330 OVERHEAD ROLLING DOORS
08460 AUTOMATIC ENTRANCE DOORS
08520 ALUMINUM WINDOWS
08710 DOOR HARDWARE
08805 GLASS AND GLAZING

DIVISION 09 - FINISHES

09250 GYPSUM BOARD
09445 RESINOUS TERRAZZO FLOORING
09510 ACOUSTICAL CEILINGS
09670 TROWEL APPLIED EPOXY FLOORING
09900 PAINTS AND COATINGS

DIVISION 10 - SPECIALTIES

10153	TOILET PARTITIONS
10350	FLAG POLES
10440	INTERIOR SIGNAGE
10523	PORTABLE FIRE EXTINGUISHERS
10800	TOILET ACCESSORIES

DIVISION 12 - FURNISHINGS

12490	WINDOW TREATMENT

DIVISION 15 - MECHANICAL

15003	GENERAL MECHANICAL PROVISIONS
15050	BASIC MECHANICAL MATERIALS AND METHODS
15072	VIBRATION ISOLATION FOR AIR CONDITIONING EQUIPMENT
15080	MECHANICAL INSULATION
15110	VALVES
15181	HYDRONIC WATER PIPING SYSTEMS
15400	PLUMBING, GENERAL PURPOSE
15410	PLUMBING FIXTURES
15520	EXTERIOR GROUND LOOP HEAT EXCHANGERS
15521	GEOTHERMAL HEAT PUMP AND LOOP PIPING SYSTEMS (HIGH DENSITY POLYETHYLENE)
15522	THERMAL-ENHANCED BENTONITE GROUT
15740	GROUND SOURCE HEAT PUMPS
15741	100% O.A. GROUND SOURCE HEATPUMP WITH ENERGY RECOVERY WHEEL
15810	DUCTWORK AND DUCTWORK ACCESSORIES
15900	AUTOMATIC TEMPERATURE CONTROLS
15910	DIRECT DIGITAL CONTROL SYSTEMS
15950	HVAC TESTING/ADJUSTING/BALANCING

DIVISION 16 - ELECTRICAL

16050	BASIC ELECTRICAL MATERIALS AND METHODS
16234	DIESEL ENGINE-GENERATOR SETS - PRIME AND STANDBY - 10 TO 500 KW
16262	AUTOMATIC TRANSFER SWITCH
16402	INTERIOR DISTRIBUTION SYSTEM
16510	INTERIOR LIGHTING
16520	EXTERIOR LIGHTING
16751	CLOSED CIRCUIT TELEVISION SYSTEMS
	APPENDIX A-GHX INSPECTION AND TEST REPORT (FORM 1)

APPENDIX B-GEOTECHNICAL REPORT FOR INFORMATION PURPOSES ONLY
APPENDIX C-500-MILE RADIUS MAP (WASHINGTON DC)
APPENDIX D- LEED CHECKLIST
APPENDIX E - PHASE II ENVIRONMENTAL SITE ASSESSMENT

-- End of Project Table of Contents --

APPENDICES (contained in Volume 2 of 2 of Project Manual)

A - FOR INFORMATION ONLY: GHX Inspection and Test Report (Form 1)

B - FOR INFORMATION ONLY: Report of Subsurface Exploration and Geotechnical Engineering Evaluation Prepared by Froehling & Robertson, June 2006.

C - FOR INFORMATION ONLY: 500 Mile Radius Map (Washington, DC)

D - FOR INFORMATION ONLY: LEED Checklist

E - FOR INFORMATION ONLY: Phase II Environmental Site Assessment Prepared by MSA, PC, July 2006.

DRAWINGS (drawings are separate documents from the Project Manual)

List of Drawings on Following Page

VIRGINIA DEPARTMENT OF TRANSPORTATION
NEW KENT SAFETY REST AREA & INFORMATION CENTER
501-06501-005

LIST OF DRAWINGS

TS1 Cover Sheet
TS2 Sheet Index, Abbreviations, & Symbols

C1 Survey Data & Layout Plan
C2 Site Plan
C3 Enlarged Site Plan
C4 E&S Control, Grading, & Storm Drain Plan
C5 Roof Drain & Cistern Plan w/ Details
C6 Utility Plan
C7 Signage & Pavement Marking Plan # 1
C8 Signage & Pavement Marking Plan # 2
C9 Construction Details #1
C10 Construction Details #2
C11 Erosions & Sediment Control Notes and Details
C12 Bio-Retention & Storm Drain Details
C13 Enlarged Geothermal Site Plan
C14 Utility Details
C15 Utility Notes & Details
C16 Car Baseline Profile
C17 Truck Baseline Profile
C18 Storm System Profile #1
C19 Storm System Profile #2
C20 Water & Sanitary Sewer Profile

L1 Landscape Plan
L2 Enlarged Landscape Plan
L3 Landscape Notes & Details

D1 Demolition Plan & Notes

A1 Floor Plan
A2 Reflected Ceiling Plan
A3 Roof Plan & Details
A4 Exterior Elevations
A5 Exterior Elevations
A6 Building Sections
A7 Wall Sections
A8 Door Schedule Details
A9 Door & Window Details
A10 Finish Schedule & Details

A11 Interior Elevations
A12 Interior Elevations

S1 Foundation Plan, Notes and Footing Schedule
S2 Roof Framing Plan, Sections, & Details
S3 Building Sections & Details
S4 Trusses & Framing Details
S5 Structural Details
S6 Cistern Plan, Details, and Plumbing

FP1 Fire Protection Plan

P1 General Notes, Legend
P2 Supply Piping Plan and Supply Riser Diagram
P3 Sanitary Piping Floor Plans
P4 Sanitary Iso. Diagram & Fixture Schedule
P5 Rainwater Harvest System Layout and Details

M1 General Notes and Legend
M2 Mechanical Schedules
M3 Mechanical Ductwork Floor and Attic Plans
M4 Mechanical Piping Partial Floor Plan
M5 Mechanical Details & Control Diagrams
M6 Mechanical Control and Flow Diagrams

E1 Electrical Legend and Riser Diagram
E2 Electrical Site Plan
E3 Electrical Lighting Plan
E4 Electrical Power Plan
E5 Electrical Power Part Plans
E6 Electrical Signal Plan
E7 Electrical Details and Panel Board Schedules

INVITATION FOR BID (IFB)

COMMONWEALTH OF VIRGINIA
VIRGINIA DEPARTMENT OF TRANSPORTATION
1201 EAST BROAD STREET
RICHMOND, VIRGINIA

Date _____

Project Title – New Kent Safety Rest Area & Information Center I-64 West, New Kent County, VA
Contractual Work – **IFB 743-RD**
Project Code – 501-06501-005
Bid Receipt Date: 2:00 P.M. (EDT) September 14, 2006
Bid Opening Date: 2:00 P.M. (EDT) September 15, 2006

Sealed bids will be **received** through the Bid Receipt time and date as stated above. The bids so received will be **opened** and publicly read at the time and date stated above. The opening will take place in the "Bid Room" located on the first floor, 1201 East Broad Street, Richmond, Virginia. Bid or proposal receipt deadlines and public openings scheduled during a period of suspended state business operations will be rescheduled for processing at the appropriate times on the next regular business day.

Job Location: Mile Marker 213, I-64 Westbound
New Kent County, Virginia

In compliance with your IFB, the undersigned bidder proposes to furnish all labor and materials and perform all work necessary for construction of this project, in accordance with the contract documents dated August 3, 2006 including Addenda noted below, as prepared by DJG, Inc., Williamsburg, VA for the consideration of the following **TOTAL BASE BID AMOUNT:**

BID FORM - BASE BID (INCLUDING THE FOLLOWING PARTS BUT EXCLUDING WORK IN ADDITIVE BID ITEMS):

PART A.

Lump sum price for construction of the building within a perimeter extending 5 feet from the walls of the building complete, except for the excavation of additional unsuitable material in PART C and in accordance with the drawings and specifications:

PART A = _____DOLLARS ($_____)

PART B.

Lump sum price for site work beyond the 5 feet building perimeter, complete, except for work described in PART A, and in accordance with the drawings and specifications.

PART B = _____DOLLARS ($_____).

NAME OF BIDDER _____

Base Bid for PART C shall be based on the estimated quantities indicated to be provided complete, and in accordance with the applicable portions of the plans and specifications. Payment amounts for each of these items will be based on the actual quantities authorized, provided, and approved times the unit costs indicated by the bidder. The final contract amount shall be adjusted upward or downward based on the actual payment amounts versus the bid amounts for PART C.

PART C. EXCAVATION OF ADDITIONAL UNSUITABLE MATERIAL

Excavation of unsuitable material, where authorized or directed, below the levels required for the work in Parts A and B and backfill with compacted material per specifications. Final amount shall be adjusted upward or downward based on actual quantity authorized.

Estimated quantity of 25 cy @ $_____per cy=_____

PART C = _____DOLLARS ($_____).

TOTAL BASE BID AMOUNT (PARTS A, B, and C) IS:

_____ DOLLARS ($_____).

Procedures for submitting a bid, claiming an error, withdrawal of bids and other pertinent information are contained in the Instructions to Bidders. Withdrawal due to error in accordance with Section 2.2-4330.A. (ii), Code of Virginia. Owner reserves the right to reject any or all bids.

Contractor registration in accordance with Title 54.1, Chapter 11 of the Code of Virginia is required.

Contract award shall be based on the Total Base Bid Amount shown above (including any properly submitted bid modifications).

Indicate approximate percent of bid estimated for the removal of asbestos-containing materials: _____%. Administrative Services must approve pre-Abatement Asbestos Submittals before the contract will be awarded.

Time For Completion:

The undersigned understands that time is of the essence and agrees that the mandatory date for Final Completion of the entire project shall be on or before June 9, 2007 based on a Notice authorizing Work to proceed on or before October 12, 2006. The Contractor shall obtain a determination of Substantial Completion by the A/E prior to Final Completion.

Incentive/Disincentive Clauses:

If the Contractor completes the project, in its entirety (Final Completion), by **April 10, 2007**, the Contractor is entitled to an early completion incentive of $300,000 payable by the Department. No incentive payments or portions thereof are offered for project completion past **April 10, 2007.**

If the Contractor completes the project, in its entirety, by **April 10, 2007** and elects to receive the early completion incentive payment, the Contractor shall notify the Department in writing within 5 calendar days after project completion of such election. The Contractor's incentive payment election notification shall be documented by executing the "Early Completion Incentive and Release of All Claims" form which is included in the Project Manual. This form shall be signed and certified by the Contractor to be all-inclusive, final, and absolute, except any routine final estimating quantity adjustments at the sole discretion of the

Department. If such notification and properly executed form is not received by the Department within 5 calendar days of the actual date of early project completion, the Contractor is not eligible for the incentive payment.

The mandatory project completion date for this contract is **June 9, 2007**. If the **June 9, 2007** mandatory project completion date is not met by the Contractor, a disincentive of $5,000 for each full day past **June 9, 2007** for which the project is not complete will be deducted from the total contract price until the date of actual project completion or a maximum of 60 calendar days. Project completion is determined at the sole discretion of the Department. Such disincentive and corresponding deductions from the total contract price shall not constitute a penalty or damage in any form. If the project is not complete within 60 calendar days of the mandatory project completion date, the Contractor will be in default of the Contract. Such disincentive shall not preclude the Department from taking any other Contract actions or measures as necessary to ensure contract compliance.

Upon award of contract, the Contractor fully acknowledges and agrees that the disincentive clause, the Department's action to exercise the disincentive clause, and any corresponding deductions from the total contract price do not constitute a penalty or damage in any form. Further, the Contractor agrees that no causes, claims, disputes, damages, suits, or any other actions will be taken or filed against the Department for any such disincentives and corresponding deductions from the total contract price.

Pre-Bid Conference:

A pre-bid conference will be held at 10:00am, August 22, 2006 at the Brookfield Complex, 6600 W. Broad Street, Richmond, Virginia. The project includes a Construction Risk Allocation Program which will be discussed in detail at the pre-bid conference. Attendees should include all General Contractors intending to submit a bid and all subcontractors who have an anticipated contract value over $100,000.

Bidders are encouraged to visit the site of the proposed work. The project site is open to the public and may be visited by prospective bidders at any time prior to the receipt of bids. The submission of a bid will be considered as conclusive evidence that the bidder has made such examination and/or is satisfied as to the conditions to be encountered in performing the work.

Bid Bond:

A five percent (5%) bid bond is required to accompany this bid.

Performance and Payment Bonds:

Shall be in accordance with Section 8 of the General Conditions of the Construction Contract G.S. Form E&B CO-7.

Weather Delays:

The bidder will rely upon the following public historical climatological records:

NOAA National Climate Data Center report for Richmond International Airport, Richmond, VA

Insurance Requirements:

Shall be in accordance with Sections 11 and 12a of the General Conditions of the Construction Contract G.S. Form E&B CO-7. Commonwealth of Virginia Contract Between Owner and Contractor, Form CO-9, will not be issued prior to receipt of required insurance certificates. **All Certificates of Insurance shall**

name Virginia Department of Transportation additionally insured.

Payment to Subcontractors:

A contractor awarded a contract under this solicitation is hereby obligated:

a. To pay the subcontractor(s) within seven (7) days of the contractor's receipt of payment from the Commonwealth for the proportionate share of the payment received for work performed by the subcontractor(s) under the contract; or

b. To notify the agency and the subcontractor(s), in writing, of the contractor's intention to withhold payment and the reason.

The contractor is obligated to pay the subcontractor(s), interest at the rate of one percent a month (unless otherwise provided for under the terms of the contract) on all amounts owed by the contractor that remain unpaid seven (7) days following receipt of payment from the Commonwealth, except for amounts withheld as stated in b. above. The date of mailing of payment by U.S. Mail is deemed to be payment to the addressee. These provisions apply to each sub-tier contractor performing under the primary contract. A contractor's obligation to pay an interest charge to a subcontractor may not be construed to be an obligation for the Commonwealth.

Registration:

Registration with the Virginia State Board for Contractors is required.

Contractor Class _____ Virginia License Number _____

Specialty _____ Valid Until _____

I certify that the firm signing this bid and registered under the name is legally qualified to perform all work included in the scope of the contract as determined by the Commonwealth of Virginia, Department of Commerce, State Board for Contractors, in granting the registration.

Pursuant to Virginia Code 18.2-498.4, this firm hereby certifies that its bid, or any portion thereof, on IFB No. 743-RD was not the result of, or affected by any act of collusion with another person engaged in the same line of business or commerce; or any act of fraud punishable under the Virginia Governmental Frauds Act.

Bidder: _____
(Name of Firm)

Business Address: _____ Phone Number _____

_____ Fax Number _____

By:_____ _____
(Signature) (Typed Name)

Date: _____ _____
(Title)

For Partnership (Names of Partners): For Corporation, list State of Incorporation:

_____ _____

_____ _____

(Corporate Seal)

Federal Identification Number (FIN):

Provide in the space below your firms nine (9) digit Federal Tax Identification Number, or if an individual, your Social Security Number. Award of a Purchase Order or contract will not be made until such number is provided.

F.I.N. or S.S. Number _____

Submission of Bid:

Submit bid on this form in accordance with Section 4, Preparation and Submission of Bids of the Instructions to Bidders. Withdrawal due to error in bid will be permitted in accordance with Section 9, Withdrawal or Modification of Bids of the Instructions to Bidders and §11-54A (ii), Code of Virginia. The Owner reserves the right to reject any or all bids. Bids shall be submitted in an envelope plainly marked with the information below in the lower left hand corner.

Opening date and hour - **2:00 P.M. (EDT), September 15, 2006**
Buyer – Robin Dolatowski , IFB No. 743-RD

Sealed Bids are to be submitted by one of the following methods:

Hand Delivered:	Reception Desk, 1st Floor, **1201** East Broad Street, Richmond, VA 23219
Mailed:	Virginia Department of Transportation **1401** East Broad Street, Richmond, VA 23219
Courier Service:	Emery, Express Mail, Federal Express, Purolator, etc., Reception Desk, 1st Floor, **1201** East Broad Street, Richmond, VA 23219

NOTE: SEALED BIDS THAT ARE HAND DELIVERED OR DELIVERED BY COURIER SERVICE WILL BE RECEIVED FROM 8:00 A.M. UNTIL 4:00 P.M. MONDAY THROUGH FRIDAY. NO DELIVERIES WILL BE RECEIVED ON OFFICIAL STATE HOLIDAYS OR WHEN STATE OFFICES ARE CLOSED.

Bids with price changes that have not been initialed will be rejected.

A "No Bid response" is required in order to remain on future mailing lists for Virginia Department of Transportation.

Telegraphic or Facsimile Bids will not be considered.

Immigration Reform and Control Act of 1986:

The undersigned certifies that it does not and will not during the performance of the Contract for this project violate the provisions of the Federal Immigration Reform and Control Act of 1986, which prohibits

employment of illegal aliens.

Disqualification of Contractors

By signing this bid (offer) the undersigned certifies that this person/firm/corporation is not currently barred from bidding on contracts by any agency of the Commonwealth of Virginia, nor is this person/firm/corporation a part of any firm/corporation that is currently barred from bidding on contracts by any previous department(s) and copies of notice(s) of reinstatement(s).

_____
Signature of Official

_____
Name of Official

_____
Title

_____
Firm or Corporation

Either the undersigned or one of the following individuals, if any, is authorized to modify this bid prior to the deadline for receipt of bids by writing the modification and signing his name; on the face of the bid, on the envelope in which it is enclosed, on a separate document, on a document which is telefaxed to the Owner at (804) 225-4292, or by sending the Owner a telegraphic message: For modifications to bids, see Instruction to Bidders, CO-7A, Section 6.

_____

_____

_____

Questions Pertaining to This IFB:

1. Technical questions concerning the Plans and Specifications shall be submitted on the "Prebid Question Form" provided in this solicitation and faxed to:

Attn: Mr. Jacob Porter Phone (804) 662-9615 Fax (804) 662-9407

2. Questions concerning Bonds, Insurance, Terms and Conditions:

Ms. Robin Dolatowski (804) 786-3247

3. Request for Copies of the complete Bid Package:

Ms. Robin Dolatowski (804) 786-3247

PLAN HOLDERS LIST IS AVAILABLE ON OUR WEBSITE.

www.virginiadot.org/business/asd-capoutlay.asp

AWARD RESULTS: Award results will be posted for public inspection in a designated public area on the first floor of the Transportation Building located at 1201 East Broad Street. Award results will be furnished if a **SELF-ADDRESSED STAMPED ENVELOPE** is supplied with bid.

BUYING VOLUME PROHIBITS GIVING RESULTS BY PHONE.

All questions pertaining to this work must be submitted in accordance with Section 2, Explanations to Bidders of the Instructions to Bidders.

Receiving of all addendum(s) must be shown on this bid form or the bid may not be considered.

ACKNOWLEDGMENT OF ADDENDA:

No. 1 Date:_____ Signature _____

No. 2 Date:_____ Signature_____

No. 3 Date:_____ Signature_____

No. 4 Date:_____ Signature_____

NOTICE

eVA Business-To-Government Vendor Registration: The eVA Internet electronic procurement solution, web site portal www.eVA.virginia.gov streamlines and automates government purchasing activities in the Commonwealth. The eVA portal is the gateway for vendors to conduct business with state agencies and public bodies. All vendors desiring to provide goods and/or services to the Commonwealth shall participate in the eVA Internet e-procurement solution either through the eVA Basic Vendor Registration Service or eVA Premium Vendor Registration Service. All bidders must register in eVA prior to award; failure to register may result in the bid being rejected.

a. eVA Basic Vendor Registration Service: $25 Annual Registration Fee plus the appropriate order Transaction Fee specified below. eVA Basic Vendor Registration Service includes electronic order receipt, vendor catalog posting, on-line registration, electronic bidding, and the ability to research historical procurement data available in the eVA purchase transaction data warehouse.

b. eVA Premium Vendor Registration Service: $25 Annual Registration Fee plus the appropriate order Transaction Fee specified below. eVA Premium Vendor Registration Service includes all benefits of the eVA Basic Vendor Registration Service plus automatic email or fax notification of solicitations and amendments,

c. For orders issued prior to August 16, 2006, the Vendor Transaction Fee is 1%, capped at a maximum of $500 per order,

d. For orders issued August 16, 2006 and after, the Vendor Transaction Fee is:

(i) DMBE-certified Small Business: 1%, capped at $500 per order.
(ii) Businesses that are not DMBE-certified Small Business: 1% capped at $1500 per order.

INSTRUCTIONS TO BIDDERS

The Invitation For Bids (IFB) consists of the Notice, this Instructions To Bidders, the Bid Form, the Pre-Bid Question Form, the General Conditions of the Construction Contract, the Supplemental General Conditions (if any), the Special Conditions (if any), the Forms to be used, and the Scope of Work as described by the Plans and Specifications, other documents listed in the Specifications, and any addenda which may be issued, all of which request qualified bidders to submit competitive prices or bids for providing the described work on the project.

eVA BUSINESS-TO-GOVERNMENT VENDOR REGISTRATION: The eVA Internet electronic procurement solution, web site portal http://www.eva.virginia.gov , streamlines and automates government purchasing activities in the Commonwealth. The portal is the gateway for vendors to conduct business with state agencies and public bodies. All vendors desiring to provide goods and/or services to the Commonwealth shall be registered in eVA. **All bidders or offerors for construction or architectural/engineering services must be registered in eVA prior to contract award.** Either Basic or Premium Registration may be selected. In addition to the annual eVA Registration Fee, vendors must agree to pay a Supplier Transaction Fee for each order/contract. Refer to the eVA Billing and Payment Portal http://www.eva.virginia.gov/billing for the current eVA Fee Schedule.

1. **CONDITIONS AT SITE OR STRUCTURE**: Bidders shall visit the site and shall be responsible for ascertaining pertinent local conditions such as location, accessibility, general character of the site or building, and the character and extent of existing work within or adjacent to the site. Claims, as a result of failure to have done so, will not be considered by the Owner. See Section 7 of the General Conditions entitled "Conditions at Site."

2. **EXPLANATIONS TO BIDDERS:** No oral explanation in regard to the meaning of drawings and specifications will be made and no oral instructions will be given before the award of the contract. Discrepancies, omissions or doubts as to the meaning of drawings and specifications shall be communicated in writing to the Architect / Engineer for interpretation. Bidders **must** use the "Prebid Question Form" provided in the bid documents. Bidders must so act to assure that questions reach the Architect/Engineer at least six (6) days prior to the time set for the receipt of bids to allow a sufficient time for an addendum to reach **all bidders** before the submission of their bids. If, however, there are two (2) weeks or less between the first bid advertisement and the time set for receipt of bids, then bidders must submit questions so that they reach the A/E no later than three (3) days prior to the time set for receipt of bids. Any interpretation made will be in the form of an addendum to the specifications which will be forwarded to all bidders, and its receipt shall be acknowledged by the bidder on Bid Forms.

3. **TIME FOR COMPLETION**:

   (a) "Time for Completion" shall be designated by the Owner on the Invitation for Bids or other prebid documents and shall mean the number of consecutive calendar days following the issuance of the Notice to Proceed which the Contractor has to substantially complete all Work required by the Contract. In some instances, the Time for Completion may be stated in the form of a Contract Completion Date based on a stipulated date of Notice to Proceed.

   Unless otherwise specified, the Contractor shall achieve Final Completion within thirty (30) days after the date of Substantial Completion.

(b) When the Notice to Proceed is issued, it will state a Contract Completion Date, which has been set by the Owner based on date of the Notice to Proceed and the Time for Completion.

(c) The Contractor, in preparing and submitting his bid, is required to take into consideration normal weather conditions. Normal weather does not mean statistically average weather, but rather means a range of weather conditions which might be anticipated, (i.e., conditions which are not extremely unusual). Normal weather conditions shall be determined from the public historical records available, including the U.S. Department of Commerce, Local Climatological Data Sheets, Oceanic and Atmospheric Administration/Environmental Data and Information Service, National Climatic Center and the National Weather Service. The data sheets to be used shall be for the locality or localities closest to the site of the work. No additional compensation will be paid to the Contractor because of adverse weather conditions; however, an extension of time for abnormal weather will be considered by the Owner as indicated in the General Conditions.

(d) If the Owner designates the public historical climatological records to be used, the bidder shall use those records in computing bids. If the Owner requests each bidder to indicate the records used, each bidder may select the public historical climatological records upon which he will rely in computing his bid. In the latter situation, each bidder shall designate in the space provided which of such climatological data records he used when formulating his bid. A bidder's failure to designate climatological records when submitting a bid shall not disqualify his bid, but shall constitute a waiver of the right to claim any extension of time as the result of abnormal weather. In either case, the bid submitted and the time of completion shall be presumed to have been based upon normal weather derived from the climatological records used.

4. PREPARATION AND SUBMISSION OF BIDS:

(a) Bids shall be submitted on the forms furnished, or copies thereof, and shall be signed in ink. Erasures or other changes in a bid must be explained or noted over the signature of the bidder. Bids containing any conditions, omissions, unexplained erasures, alterations or items not called for in the proposal, or irregularities of any kind, may be rejected by the Owner as being incomplete or non-responsive.

(b) Each bid must give the complete legal name and full business address of the bidder and be signed by the bidder, or the bidder's authorized representative, with his usual signature. Bids by partnerships must be signed in the partnership name by one of the general partners of the partnership or an authorized representative, followed by the designation/title of the person signing, and a list of the partners. Bids by joint ventures must be signed in the joint venture name by one of the joint venturers or an authorized representative of one of the joint venturers, followed by the designation/title of the person signing, and a list of the joint venturers. Bids by corporations must be signed with the legal name of the corporation followed by the name of the state in which it is incorporated and by the signature and title of the person authorized to bind it in this matter. The name of each person signing shall be typed or printed below the signature. A signature on a bid by a person who identifies his title as "President," "Secretary," "Agent" or other designation without disclosing the principal firm, shall be held to be the bid of the individual signing. When requested by the Owner, satisfactory evidence of the authority of the officer signing on behalf of the corporation shall be furnished. Trade or fictitious names may be referenced by using "t/a _ _ _," but bids shall be in the legal name of the person or entity submitting the bid.

(c) Bids with the bid guarantee shall be enclosed in a sealed envelope which shall be marked and addressed as indicated by the advertisement. If a contract is for one hundred twenty thousand dollars ($120,000) or more, or if the total value of all construction, removal, repair or improvements undertaken by the bidder within any twelve-month period is seven hundred fifty thousand dollars

($750,000) or more, the bidder is required under Title 54.1, Chapter 11, Section 1100, Code of Virginia, as amended, to be licensed in Virginia as a "Class A Contractor." If a contract is for seven thousand five hundred dollars ($7,500) or more, but less than one hundred twenty thousand dollars ($120,000), the bidder is required to be licensed in Virginia as a "Class B Contractor." The bidder shall place on the outside of the envelope containing the bid and shall place in the bid over his signature whichever of the following notations is appropriate and insert his Contractor license/registration number:

Licensed Class A Virginia Contractor No. _____
or
Licensed Class B Virginia Contractor No. _____

If the bidder is not properly licensed in Virginia at the time the bid is submitted, or if the bidder fails to provide this information on his bid or on the envelope containing the bid and fails to promptly provide said Contractor license number to the Owner in writing when requested to do so before or after the opening of bids, he shall be deemed to be in violation of Section 54.1-1112 of the Code of Virginia, as amended, and his bid will not be considered.

(d) The Board for Contractors has interpreted its regulations to mean "a licensed Contractor can bid on a contract which contains work outside his license classification(s) as long as he subcontracts those items for which he is not qualified to perform to licensed contractors with the appropriate License Classification and the work of the second party is incidental to the contract." Therefore, the Owner may, as a part of determining whether the bidder is "responsible," require the apparent low bidder to submit a listing of his subcontractors along with the license number and classification or specialty of each.

(e) The bidder must also place its Employer Identification Number (SSN or FEIN) in the space provided on the Bid Form.

5. BID GUARANTEE:

(a) Any bid (including the Total Base Bid plus all Additive Bid Items) which exceeds one hundred thousand dollars ($100,000) shall be accompanied by a **Commonwealth of Virginia Standard Bid Bond, Form CO-10.2**, payable to the Owner as obligee in an amount equal to five percent (5%) of the amount of the bid. A Bid Bond may be required for projects having bids of less than one hundred thousand dollars ($100,000) if such requirement is stated in the Notice of Invitation for Bids. The Bid Bond must be issued by a surety company which is legally authorized by the Virginia State Corporation Commission to do fidelity and surety business in the Commonwealth of Virginia. Such Bid Bond shall guarantee that the bidder will not withdraw his bid during the period of thirty (30) days following the opening of bids; that if his bid is accepted, he will enter into a formal contract with the Owner in accordance with the Contract Between Owner and Contractor, Form CO-9, included as a part of the IFB Documents; that he will submit a properly executed and authorized Standard Performance Bond and Standard Labor and Material Payment Bond on the forms included in the IFB documents; and that in the event of the withdrawal of said bid within said period, or failure to enter into said contract and give said bonds within ten (10) days after he has received notice of acceptance of his bid, the bidder shall be liable to the Owner for the difference between the amount specified in said bid and such larger amount for which the Owner may contract with another party to perform the work covered by said bid, up to the amount of the bid guarantee. This amount represents the damage to the Owner on account of the default of the bidder in any particular hereof. See **§2.2-4336** of the Code of Virginia, as amended.

(b) See **§2.2-4338** of the Code of Virginia for provisions allowing alternative forms of bid security in lieu of a Bid Bond. Forms of Security listed in **§2.2-4338.B** must be approved prior to submission of a Bid on the Bid Receipt date and time to be acceptable as Bid Security.

(c) The Bid Bonds or other bid security will be returned to all except the three lowest bidders after the formal opening of bids. The remaining Bid Bonds or bid security will be returned to the bidders after the Owner and the accepted bidder have executed the Contract and the Performance Bond and the Payment Bond have been approved by the Owner.

(d) If the required Contract and bonds have not been executed within thirty (30) days after the date of the opening of the bids, then the bond or other bid security of any bidder will be returned upon his request, provided he has not been notified of the acceptance of his bid prior to the date of such request.

6. **WITHDRAWAL OR MODIFICATION OF BIDS**: Bids may be withdrawn or modified by written or telefaxed notice received at the designated location from bidders prior to the deadline fixed for bid receipt. E-mail modifications are not acceptable. The withdrawal or modification may be made by the person signing the bid or by an individual(s) who is authorized by him on the face of the bid. Written modifications may be made on the bid form itself, on the envelope in which the bid is enclosed, or on a separate document. Written modifications, whether the original is delivered or telefaxed, must be signed by the person making the modification or withdrawal. The modification must state specifically what is to be modified and by what amount or it must state the item to be modified and what the corrected amount should be. (e.g. "Deduct $25,000 from Part A and from the Total Base Bid Amount"; or "Add $23,456 to the Total Base Bid Amount"; or "Deduct $15,650 from the Additive # 2 amount". A modification to "Deduct $25,000 from Part A" will only be applied to Part A and not to the Total Base Bid Amount) **Unless otherwise specified by the Bidder in the modification, the modification will be applied to the TOTAL BASE BID AMOUNT shown on the Bid Form.** (e.g. a modification stating only "Deduct $25,000" which is properly signed will be deducted from the Total Base Bid Amount shown on the Bid Form)

7. **RECEIPT OF BIDS**:

(a) **Bids will be received at or before the date and the hour and at the place stipulated in the Invitation for Bids as may be modified by subsequent Addenda.**

(b) **It is the responsibility of the bidder to assure that his bid and any bid modifications are delivered to the place designated for receipt of bids by the date and hour (deadline) set for receipt of bids. Therefore, it is the bidder's responsibility to take into account all factors which may impact on its bid deliverer / courier's ability to deliver the bid and to implement whatever actions are necessary to have the bid delivered to the proper bid receipt location prior to the bid receipt deadline.** No bids or bid modifications submitted or offered after the date and hour designated for receipt of bids will be accepted or considered.

(c) The Bid Officer is the Owner's representative designated to receive bids at the time and place noted in the IFB and to open the bids received at the appointed time.

(d) **The official time used for the receipt of responses is determined by reference to the clock designated by the Bid Officer.** The Bid Officer shall determine when the Bid Receipt Deadline has arrived and shall announce that the Deadline has arrived and that no further bids or bid modifications will be accepted. All bids and bid modifications in the possession of the Bid Officer and his assistants at the time the announcement is completed are deemed to be timely, whether or

not the bid envelope has been physically date/time stamped or otherwise marked by the time the Bid Officer makes the deadline announcement.

8. **OPENING OF BIDS**:

(a) Bids will be opened at the time and place stated in the Invitation for Bids or as modified by subsequent Addenda, and their contents publicly announced. The Bid Officer shall decide when the specified time for bid opening has arrived. No responsibility will be attached to any officer or agent for the premature opening of a bid not properly addressed and identified. Bid opening shall be no sooner than 24 hours after the time set for receipt of bids.

(b) The provisions of **§2.2-4342** of the Code of Virginia, as amended, shall be applicable to the inspections of bids received.

9. **ERRORS IN BIDS:** A bidder may withdraw his bid from consideration if the price bid was substantially lower than the other bids due solely to a mistake therein, provided the bid was submitted in good faith, and the mistake was a clerical mistake as opposed to a judgment mistake, and was actually due to an unintentional arithmetic error or an unintentional omission of a quantity of work, labor or material made directly in the compilation of a bid, which unintentional arithmetic error or unintentional omission can be clearly shown by objective evidence drawn from inspection of original work papers, documents and materials used in the preparation of the bid sought to be withdrawn.

In accordance with **§2.2-4330.A.(ii)** of the Code of Virginia, the bidder must submit to the Owner his original work papers, documents and materials used in the preparation of the bid within one day after the date fixed for submission of bids. Such work papers must be submitted in an envelope or package separate and apart from the envelope containing the bid and marked clearly as to the contents and shall be delivered to the Owner by the bidder in person or by registered mail prior to the time fixed for the opening of bids and may not be withdrawn until after the two-hour period (referred to later) has elapsed. The bids shall be opened at the time designated in the IFB, as amended by addendum. Bid opening is usually one day following the time fixed by the Owner for the submission of bids, but no sooner. Once the bids have been opened, the bidder shall have two (2) hours after the opening of bids within which to claim in writing any mistake as defined herein and withdraw his bid. The Contract shall not be awarded by the Owner until such two-hour period has elapsed. Such mistake shall be proved only from the original work papers, documents and materials delivered to the Owner prior to bid opening. This procedure (ii) shall not apply to when the entire bid is required to be submitted on a unit price basis.

Failure of a bidder to submit his original work papers, documents and materials used in the preparation of his bid on or before the time, date and place required shall constitute a waiver by that bidder of his right to withdraw his bid due to a mistake.

No bid may be withdrawn under this section when the result would be the awarding of the Contract on another bid of the same bidder or of another bidder in which the ownership of the withdrawing bidder is more than five (5%) percent.

No bidder who is permitted to withdraw a bid shall, for compensation, supply any material or labor to or perform any subcontract or other work agreement for the person or firm to whom the Contract is awarded or otherwise benefit, directly or indirectly, from the performance of the project for which the withdrawn bid was submitted. The person or firm to whom the Contract was awarded and the withdrawing bidder are jointly liable to the Owner in an amount equal to any compensation paid to or for the benefit of the withdrawing bidder without such approval.

If a bid is withdrawn under authority of this section, the lowest remaining bid shall be deemed to be the low bidder on the project.

10. REJECTION OF BIDS: The Owner reserves the right to cancel the Invitation for Bids, to reject any and all bids at its sole discretion when such rejection is in the interest of the Owner, or to reject the bid of any bidder who is determined to be not responsive or not responsible. See **§2.2-4319**, Code of Virginia, as amended.

11. DETERMINATION OF RESPONSIBILITY

Each bidder shall be prepared, if so requested by the Owner, to present evidence of his experience, qualifications and financial ability to carry out the terms of the Contract.

Prior to award of the Contract, an evaluation will be made to determine if the low bidder has the capability, in all respects, to perform fully the contract requirements and the moral and business integrity and reliability which will assure good faith performance, and who has been prequalified, if required. Factors to be evaluated include, but are not limited to:

(a) sufficient financial ability to perform the contract as evidenced by the bidder's ability to obtain payment and performance bonds from an acceptable surety;
(b) appropriate experience to perform the Work described in the bid documents;
(c) any judgments entered against the bidder, or any officers, directors, partners or owners for breach of a contract for construction;
(d) any substantial noncompliance with the terms and conditions of prior construction contracts with a public body without good cause where the substantial noncompliance is documented; or
(e) a conviction of the bidder or any officer, director, partner, project manager, procurement manager, chief financial officer, or owner in the last five years of a crime relating to governmental or nongovernmental construction or contracting;
(f) any current debarment of the contractor, any officer, director or owner, from bidding or contracting by any public body of any state, any state agency, or any agency of the federal government.

The Owner reserves the right to disqualify or refuse to accept the bid of any bidder who has been convicted, or entered a plea of guilty or nolo contendere, in any federal or state court to any charge involving any unlawful, corrupt or collusive practice involving a public contract whether federal, state, or local, or who has been determined in any judicial proceeding to have violated any antitrust, bid-rigging or collusive practice statute in connection with any public contract, or against whom such formal criminal prosecution or other judicial proceeding has been initiated.

A bidder who, despite being the apparent low bidder, is determined not to be a responsible bidder shall be notified in writing in conformance with the procedures in **§2.2-4359** of the Code of Virginia, as amended.

12. AWARD OF CONTRACT

(a) **Basis for Contract Award**: The Contract, if awarded, will be awarded to the lowest responsive and responsible bidder, if any, provided his bid is reasonable and it is in the best interest of the Owner to accept it and subject to the Owner's right to reject any and all bids and to waive informality in the bids and in the bidding. The Bid Form contains a multi-part Base Bid and may contain Additive Bid

Items. Determination of the lowest responsible bidder, if any, will be based on the Total Base Bid Amount **entered on the Bid Form** including any properly submitted bid modifications plus as many Additive Bid Items taken in sequence as the Owner in its discretion chooses to Award. **Where the sum of the values entered in the multiple parts do not agree with the Total Base Bid amount, the Total Base Bid amount entered on the bid form, including any properly submitted bid modifications, shall take precedence.**

eVA BUSINESS-TO-GOVERNMENT VENDOR REGISTRATION: The bidder or offeror must be a registered vendor in eVA to be awarded this contract. Failure of the Bidder to become a registered vendor in eVA by the time the Notice of Intent to Award is given will result in that bidder being declared "Not Responsible".

In the event that the Total Base Bid from the lowest responsible bidder exceeds available funds, the Owner may negotiate the Total Base Bid amount with the apparent low bidder to obtain a contract price within available funds, pursuant to §2.2-4318 of the Code of Virginia, as amended, and Section 12(c) herein.

(b) **Informalities:** The Owner reserves the right to waive any informality in the bids when such waiver is in the interest of the Owner.

(c) **Negotiation With Lowest Responsible Bidder**: If award of a contract to the lowest responsive and responsible bidder is precluded because of limitations on available funds, under the provisions of §2.2-4318 of the Code of Virginia (the Public Procurement Act), the Owner reserves the right to negotiate the Total Base Bid amount with the lowest responsive, responsible bidder to obtain a contract price within the available funds. This may involve changes in either the features or scope of the work include in the Base Bid. Such negotiations with the apparent low bidder may include reducing the quantity, quality, or other cost saving mechanisms involving items in the Total Base Bid. Negotiations for Additive Bid Items are excluded. The Owner shall notify the lowest responsive and responsible bidder that such a situation exists and the Owner and bidder shall then conduct their negotiations in person, by mail, by telephone or by any means they find convenient. If an acceptable contract can be negotiated, the changes to the Invitation for Bid documents agreed upon in the negotiations shall be summarized in a "Post Bid Modification" and included in the contract. If an acceptable contract cannot be negotiated, the Owner shall terminate negotiations and reject all bids.

(d) **Notice of Intent to Award or Notice of Award:** The Notice of Award, the Notice of Intent to Award, or the Notice of Decision to Award will be posted at the Agency's standard location for posting notices **as shown on the "Notice of Invitation to Bid".** In addition the Agency may also post such notice on the Agency's Website and/or the DGS central electronic procurement Website.

13. **CONTRACT SECURITY**: For contracts of more than $100,000, the Standard Performance Bond (Form CO-10) and the Standard Labor and Material Payment Bond (Form CO-10.1) shall be required, as specified in the Invitation for Bids documents. See the General Conditions and **§2.2-4337 and §2.2-4338** of the Code of Virginia, as amended. The Owner reserves the right to require such bonds for contracts less than $100,000. If the Owner so elects, the requirement shall be set forth in the Invitation For Bids.

14. **CERTIFICATION**: The bidder, by his signature on the Bid Form, certifies that neither his organization nor any of its officers, directors, partners or owners is currently barred from bidding on contracts by any Agency of the Commonwealth of Virginia, or any public body or agency of another

state, or any agency of the federal government. See the statement "Disqualification of Contractors" in the Bid Form.

15. **ETHICS IN PUBLIC CONTRACTING:** The provisions, requirements and prohibitions as contained in **Title 2.2, Chapter 43, Article 6, §2.2-4367** et seq, Code of Virginia, as amended, pertaining to bidders, offerers, contractors, and subcontractors are applicable to this project.

16. **BUILDING PERMITS**: Because this is a Project of the Commonwealth of Virginia, codes or zoning ordinances of local political subdivisions do not apply. However, the Virginia Uniform Statewide Building Code shall apply to the Work and shall be administered by the Building Official for State-owned Buildings. The Building Permit will be obtained and paid for by the Owner. All other permits, local license fees, business fees, taxes, or similar assessments imposed by the appropriate political subdivision shall be obtained and paid for by the Contractor. See Section 25 of the General Conditions for utility connection fees and services.

17. **MINORITY UTILIZATION**: It is the policy of the Commonwealth of Virginia to contribute to the establishment, preservation, and strengthening of minority business enterprises and to encourage the participation of minority businesses in State procurement activities. Towards that end, the Owner encourages firms to provide for the participation of minority owned businesses through partnerships, joint ventures, subcontracts, and other contractual opportunities.

18. **BID DOCUMENTS:** Bid Documents are the property of the Owner and a deposit in an amount as stated in the Invitation for Bids is required for each set as a guarantee of the safe return of the documents within ten (10) days of bid opening. This deposit will be refunded in full on not more than two sets to each bidder who submits a prime contract bid and who returns the documents in good condition. Refund will be made on sets to non-bidders and subcontractors in the amount of half of the deposit when the sets are returned in good condition within 10 days. A non-refundable shipping charge may be required if stated in the Notice or the Invitation For Bids.

19. **GENERAL CONDITIONS:** The General Conditions of the Construction Contract, G. S. Form E&B CO-7, are incorporated in the bid documents. If the General Conditions are incorporated by reference, the bidder may obtain a copy of the current edition of the General Conditions of the Construction Contract, G. S. Form E&B CO-7 at no cost by written request to the A/E and/or the Agency where the bid documents are obtained. Copies may also be obtained from the DGS Forms Center (http://forms.dgs.virginia.gov).

20. **PREBID CONFERENCE**: See the Invitation For Bids for requirements for a prebid conference and whether such conference is mandatory or optional.

21. **INSPECTION OF BID DOCUMENTS:** Copies of the Invitation for Bids documents including Plans and Specifications and the General Conditions of the Construction Contract, G. S. Form E&B, CO-7, current edition, will be available for inspection at the Agency, at the A/E's office, and at the locations listed in the Notice of the Invitation for Bids.

22. **DRUG-FREE WORKPLACE REQUIRED:** Bidders are reminded that **Section 2.2-4312** of the Code of Virginia requires that the during the performance of the contract resulting form this solicitation, the contractor agrees to (i) provide a drug-free workplace for the contractor's employees; (ii) post in

conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition; (iii) state in all solicitations or advertisements for employees placed by or on behalf of the contractor that the contractor maintains a drug-free workplace; and (iv) include the provisions of the foregoing clauses in every subcontract or purchase order of over $10,000, so that the provisions will be binding upon each subcontractor or vendor.

For the purposes of this section, "drug-free workplace" means a site for the performance of work done in connection with a specific contract awarded to a contractor in accordance with this solicitation, the employees of whom are prohibited from engaging in the unlawful manufacture, sale, distribution, dispensation, possession or use of any controlled substance or marijuana during the performance of the contract.

NOTE: These CO-7a, Instructions to Bidders, have been created specifically for the use of agencies of the Commonwealth of Virginia, which may not alter their provisions without the express written approval of the Virginia Department of General Services, Division of Engineering and Buildings. These Instructions to Bidders have significant legal implications and shall not be altered or modified. Nothing in the CO-7a, Instructions to Bidders, shall be amended or deleted or its intent changed, except by an approved and properly issued 'Supplemental Instruction to Bidders'. The Commonwealth makes no representation as to their suitability for any other purpose.

Paragraphs which have been added or revised since prior edition are identified with a line to the right of the paragraph.

DGS-30-272
(Rev. 02/01)

PREBID QUESTION FORM

(Use separate Form for each question submitted.)

Date: _____

Project: _____

PC# _____

The following question concerns Drawing Sheet (number)_____:

_____

_____

_____

_____

_____

_____

_____

The following question concerns Specifications Section (number) _____,
page _____, paragraph _____,

_____

_____

_____

_____

_____

All responses to questions will be made by Addendum.

Question submitted by: _____
Name Organization

Mail Form To:

Jacob Porter
VDOT Asset Management Division – Special Facilities
1401 East Broad Street
Richmond, Virginia 23219

or FAX to: 804-662-9407

COMMONWEALTH OF VIRGINIA
STANDARD BID BOND

KNOW ALL MEN BY THESE PRESENTS: That _____, the Contractor ("Principal") whose principal place of business is located at _____ and _____ ("Surety") whose address for delivery of 'Notices' is located at _____ are held and firmly bound unto the Commonwealth of Virginia, _____, the Owner ("Obligee") in the amount of five percent (5%) of the Amount (Total Base Bid plus all Additive Bid Items) Bid by Principal, for the payment whereof, Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted a bid for _____

NOW, THEREFORE, the conditions of this obligation are as follows. This Bid Bond shall guarantee that the Principal will not withdraw his bid during the period of thirty (30) days following the opening of bids; that if his bid is accepted, Principal will enter into a formal contract with the Owner in accordance with the Contract Between Owner and Contractor, Form CO-9, included as a part of the Invitation for Bids (IFB Documents); that Principal will submit a properly executed and authorized Standard Performance Bond and Standard Labor and Material Payment Bond on the forms included in the IFB documents; and that in the event of the withdrawal of said bid within said period, or failure to enter into said contract and give said bonds within ten (10) days after Principal has received notice of acceptance of his bid, Principal and Surety shall be jointly and severally liable to the Owner for the difference between the amount specified in said bid and such larger amount for which the Owner may contract with another party to perform the work covered by said bid, up to the amount of the bid guarantee. This amount represents the damage to the Owner of account of the default of the bidder in any particular thereof.

The Surety represents to the Principal and to the Obligee that it is legally authorized to do business in the Commonwealth of Virginia.

Signed and sealed this _____ day of _____

_____
Contractor / Principal **(SEAL)**

By:_____

_____
Witness

Typed Name: _____

Title: _____

_____
Surety **(SEAL)**

By:_____

Attorney-in-Fact

Typed Name: _____

AFFIDAVIT AND ACKNOWLEDGEMENT OF ATTORNEY-IN-FACT

COMMONWEALTH OF VIRGINIA
(or alternatively, Commonwealth or State of _____)

CITY of _____

I, the undersigned notary public, do certify that _____, whose name is signed to the foregoing bid bond in the amount of five percent (5%) of the Total Bid Amount and which names the Commonwealth of Virginia, _____, as Obligee, personally appeared before me today in the above jurisdiction and made oath that he/she is the attorney-in-fact of _____, a _____ corporation which is the Surety in the foregoing bond, that he/she is duly authorized to execute on the above Surety's behalf the foregoing bond pursuant to the Power of Attorney noted above and attached hereto, and on behalf of the surety, he/she acknowledged the foregoing bond before me as the above Surety's act and deed

She/he has further certified that her/his Power of Attorney has not been revoked.
[Complete if Power is recorded: Clerk's Office: _____;
Deed Book/Page No. or Instrument No.: _____.]

Given under my hand this _____ day of _____.

_____
Notary Public (SEAL)

My name (printed) is _____

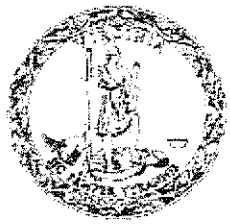
My commission expires: _____

APPROVED:

_____
Attorney General/Designee Date

Revisions: Revisions made to the 06/04 General Conditions are indicated by a vertical line in the margin as shown hereon.

COMMONWEALTH OF VIRGINIA



GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

TABLE OF CONTENTS

SECTION	TITLE	PAGE
1.	DEFINITIONS	3
2.	CONTRACT DOCUMENTS	6
3.	LAWS AND REGULATIONS	7
4.	NONDISCRIMINATION	8
5.	PROHIBITION OF ALCOHOL AND OTHER DRUGS	9
6.	TIME FOR COMPLETION	9
7.	CONDITIONS AT SITE	10
8.	CONTRACT SECURITY	11
9.	SUBCONTRACTS	11
10.	SEPARATE CONTRACTS	12
11.	CONTRACTOR'S AND SUBCONTRACTOR'S INSURANCE	13
12.	"ALL-RISK" BUILDER'S RISK INSURANCE	13
13.	TAXES, FEES AND ASSESSMENTS	14
14.	PATENTS	14
15.	ARCHITECT/ENGINEER'S STATUS	15
16.	INSPECTION	16
17.	SUPERINTENDENCE BY CONTRACTOR	18
18.	CONSTRUCTION SUPERVISION, METHODS AND PROCEDURES	18
19.	SCHEDULE OF THE WORK	19
20.	SCHEDULE OF VALUES AND CERTIFICATE FOR PAYMENT	22

21.	ACCESS TO WORK	23
22.	SURVEYS AND LAYOUT	23
23.	PLANS AND SPECIFICATIONS	24
24.	SUBMITTALS	25
25.	FEES, SERVICES AND FACILITIES	26
26.	EQUALS	27
27.	AVAILABILITY OF MATERIALS	28
28.	CONTRACTOR'S TITLE TO MATERIALS	28
29.	STANDARDS FOR MATERIALS INSTALLATION & WORKMANSHIP	28
30.	WARRANTY OF MATERIALS AND WORKMANSHIP	29
31.	USE OF SITE AND REMOVAL OF DEBRIS	29
32.	TEMPORARY ROADS	30
33.	SIGNS	30
34.	PROTECTION OF PERSONS AND PROPERTY	30
35.	CLIMATIC CONDITIONS	31
36.	PAYMENTS TO CONTRACTOR	31
37.	PAYMENTS BY CONTRACTOR	35
38.	CHANGES IN THE WORK	36
39.	EXTRAS	40
40.	CONTRACTOR'S RIGHT TO STOP WORK OR TERMINATE THE CONTRACT	41
41.	OWNER'S RIGHT TO TERMINATE THE CONTRACT FOR CAUSE	41
42.	TERMINATION BY OWNER FOR CONVENIENCE	42
43.	DAMAGES FOR DELAYS; EXTENSION OF TIME	42
44.	INSPECTION FOR SUBSTANTIAL COMPLETION & FINAL INSPECTION	44
45.	GUARANTEE OF WORK	45
46.	ASSIGNMENTS	46
47.	CONTRACTUAL DISPUTES	46
48.	ASBESTOS	47
49.	TRAINING, OPERATION AND MAINTENANCE OF EQUIPMENT	48
50.	PROJECT MEETINGS	48

PLEASE NOTE: The CO-7, General Conditions of the Construction Contract, has been created specifically for the use of agencies of the Commonwealth of Virginia, which may not alter any provisions without the express written approval of the Virginia Department of General Services, Division of Engineering and Buildings. The General Conditions have significant legal implications and shall not be altered or modified. Nothing in the CO-7, General Conditions of the Construction Contract, shall be amended or deleted or its intent changed, except by an approved and properly issued Supplemental General Condition. The Commonwealth makes no representation as to their suitability for any other purpose. (Note: Political subdivisions intending to modify the General Conditions for their use should consult with their legal counsel.)

1. DEFINITIONS

Whenever used in these General Conditions of the Construction Contract ("General Conditions") or in the Contract Documents, the following terms have the meanings indicated, which are applicable to both the singular and plural and the male and female gender thereof:

Agency: The Agency, institution or department which is a party to the Contract. For purposes of the Contract, the term Owner shall include such Agency, whether or not the Agency owns the site or the building.

Architect, Engineer, Architect/Engineer or A/E: The term used to designate the Architect and/or the Engineer that contracts with the Owner to provide the Architectural and Engineering services for the Project. The A/E is a separate contractor and not an agent of the Owner. The term includes any associates or consultants employed by the A/E to assist in providing the A/E services.

Beneficial Occupancy: The condition after Substantial Completion but prior to Final Completion of the Project at which time the Project, or portion thereof, is sufficiently complete and systems operational such that the Owner could, after obtaining necessary approvals and certificates, occupy and utilize the space for its intended use. Guarantees and warranties applicable to that portion of the Work begin on the date the Owner accepts the Project, or a portion thereof, for such Beneficial Occupancy, unless otherwise specified in the Supplemental General Conditions or by separate agreement.

Change Order: A document (Form CO-11) issued on or after the effective date of the Contract Between Owner and Contractor (Form CO-9) which is agreed to by the Contractor and approved by the Owner, and which authorizes an addition, deletion or revision in the Work, including any adjustment in the Contract Price and/or the Contract Completion Date. The term Change Order shall also include written orders to proceed issued pursuant to Section 38 (a) (3). A Change Order, once signed by all parties, is incorporated into and becomes a part of the Contract.

Code of Virginia: 1950 Code of Virginia as amended. Sections of the Code referred to herein are noted by (§ xx-xx).

construction: The term used to include new construction, reconstruction, renovation, restoration, major repair, demolition and all similar work upon buildings and ancillary facilities, including any draining, dredging, excavation, grading or similar work upon real property.

Contract: The Contract Between Owner and Contractor, Form CO-9, hereinafter referred to as the Contract.

Contract Completion Date: The date by which the Work must be substantially complete. The Contract Completion Date is customarily established in the Notice To Proceed, based on the Time for Completion. In some instances, however, the Contract contains a mandatory Contract Completion Date, which shall be stated in the Invitation for Bid.

Contract Documents: The Contract Between Owner and Contractor (Form CO-9) signed by the Owner and the Contractor and any documents expressly incorporated therein. Such incorporated documents customarily include the bid submitted by the Contractor, these General Conditions, any Supplemental General Conditions, any Special Conditions, the plans and the specifications, and all modifications, including addenda and subsequent Change Orders.

Contract Price: The total compensation payable to the Contractor for performing the Work, subject to modification by Change Order.

Contractor: The person with whom the Owner has entered into a contractual agreement to do the Work.

Day(s): Calendar day(s) unless otherwise noted.

Defective: An adjective which, when modifying the word Work, refers to Work that is unsatisfactory, faulty, deficient, does not conform to the Contract Documents **or** does not meet the requirements of inspections, standards, tests or approvals required by the Contract Documents, or Work that has been damaged prior to the A/E's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion or Beneficial Occupancy).

Drawing: A page or sheet of the Plans which presents a graphic representation, usually drawn to scale, showing the technical information, design, location, and dimensions of various elements of the Work. The graphic representations include, but are not limited to, plan views, elevations, transverse and longitudinal sections, large and small scale sections and details, isometrics, diagrams, schedules, tables and/or pictures.

Emergency: Any unforeseen situation, combination of circumstances, or a resulting state that poses imminent danger to health, life or property.

Final Completion Date: The date of the Owner's acceptance of the Work from the Contractor upon confirmation from the Architect/Engineer and the Contractor that the Work is totally complete in accordance with Section 44(b).

Field Order: A written order issued by the A/E which clarifies or explains the plans or specifications, or any portion or detail thereof, without changing the design, the Contract Price, the Time for Completion or the Contract Completion Date.

Float: The excess time included in a construction schedule to accommodate such items as inclement weather and associated delays, equipment failures, and other such unscheduled events. It is the contingency time associated with a path or chain of activities and represents the amount of time by which the early finish date of an activity may be delayed without impacting the critical path and delaying the overall completion of the Project. Any difference in time between the Contractor's approved early completion date and the Contract Completion Date shall be considered a part of the Project float.

Float, Free: The time (in days) by which an activity may be delayed or lengthened without impacting upon the start day of any activity following in the chain.

Float, Total: The difference (in days) between the maximum time available within which to perform an activity and the duration of an activity. It represents the time by which an activity may be delayed or lengthened without impacting the Time for Completion or the Contract Completion Date.

Notice: All written notices, including demands, instructions, claims, approvals and disapprovals, required or authorized under the Contract Documents. Any written notice by either party to the Contract shall be sufficiently given by any one or combination of the following, whichever shall first occur: (1) delivered by hand to the last known business address of the person to whom the notice is due; (2) delivered by hand to the person's authorized agent, representative or officer wherever they may be found; or (3) enclosed in a postage prepaid envelope addressed to such last known business address and delivered to a United States Postal Service official or mailbox. Notice is effective upon such delivery. All notices to the Owner should be directed to the Project Manager.

If the Owner and the Contractor agree in writing that Notices transmitted by Facsimile (Fax) are acceptable for the Project, such Notice shall be transmitted to the Fax number listed in the agreement and shall have a designated space for the Fax Notice recipient to acknowledge his receipt by authorized signature and date. The Fax Notice with authorized signature acknowledging receipt shall be Faxed back to the sender. The Faxed Notice shall be effective on the date it is acknowledged by authorized signature. All Faxed Notices shall also be sent by hard copy, which shall be effective upon delivery, as provided herein. Notice shall be

effective upon the date of acknowledgment of the Faxed Notice or the date of delivery, whichever occurs first.

Notice to Proceed: A written notice given by the Owner to the Contractor (with a copy to A/E) fixing the date on which the Contract time will commence for the Contractor to begin the prosecution of the Work in accordance with the requirements of the Contract Documents. The Notice to Proceed will customarily identify a Contract Completion Date.

Owner: The public body with whom the Contractor has entered into a contractual agreement and for whom the Work or services is to be provided. The term "Owner", as used herein, shall also mean the Agency.

Person: This term includes any individual, corporation, partnership, association, company, business, trust, joint venture, or other legal entity.

Plans: The term used to describe the group or set of project-specific drawings which are included in the Contract Documents.

Project: The term used instead of the specific or proper assigned title of the entire undertaking which includes, but is not limited to, the "Work" described by the Contract Documents.

Project Inspector: One or more persons employed by the Owner to inspect the Work for the Owner and/or to document and maintain records of activities at the Site to the extent required by the Owner. The Owner shall notify the Contractor in writing of the appointment of such Project Inspector(s). The scope of the Project Inspector's authority with respect to the Contractor is limited to that indicated in Section 16 (e) and (f) and as supplemented by the Owner in writing to the Project Inspector and to the Contractor.

Project Manager: The Project Manager as used herein shall be the Owner's designated representative on the Project. The Project Manager shall be the person through whom the Owner generally conveys written decisions and notices. All notices due the Owner and all information required to be conveyed to the Owner shall be conveyed to the Project Manager. The scope of the Project Manager's authority is limited to that authorized by the Owner, who shall provide written information to the Contractor at the Preconstruction meeting defining those limits. Upon receipt of such information, the Contractor shall be on notice that it cannot rely on any decisions of the Project Manager outside the scope of his authority. Nothing herein shall be construed to prevent the Owner from issuing any notice directly to the Contractor. The Owner may change the Project Manager from time to time and may, in the event that the Project Manager is absent, disabled or otherwise temporarily unable to fulfill his duties, appoint an interim Project Manager.

Provide: Shall mean furnish and install ready for its intended use.

Site: Shall mean the location at which the Work is performed or is to be performed.

Specifications: That part of the Contract Documents containing the written administrative requirements and the technical descriptions of materials, equipment, construction systems, standards, and workmanship which describe the proposed Work in sufficient detail and provide sufficient information for the Building Official to determine code compliance and for the Contractor to perform the Work. (The General Conditions, any Supplemental General Conditions, various bidding information and instructions, and blank copies of various forms to be used during the execution of the Work are usually bound with the Specifications.)

Subcontractor: A person having a direct contract with Contractor or with any other Subcontractor for the performance of the Work. Subcontractor includes any person who provides on-site labor but does not include any person who only furnishes or supplies materials for the Project.

Submittals: All shop, fabrication, setting and installation drawings, diagrams, illustrations, schedules, samples, and other data required by the Contract Documents which are specifically prepared by or for the Contractor to illustrate some portion of the Work and all illustrations, brochures, standard schedules, performance charts, instructions, diagrams and other information prepared by a Supplier and submitted by the Contractor to illustrate material or equipment conformance of some portion of the Work with the requirements of the Contract Documents.

Substantial Completion: The condition when the Owner agrees that the Work, or a specific portion thereof, is sufficiently complete, in accordance with the Contract Documents, so that it can be utilized by the Owner for the purposes for which it was intended. The Owner at its sole discretion may, after obtaining the necessary approvals and certificates, take Beneficial Occupancy at this time or choose to wait to occupy until after Final Completion is achieved.

Supplemental General Conditions: That part of the Contract Documents which amends or supplements the General Conditions.

Supplier: A manufacturer, fabricator, distributor, materialman or vendor who provides material for the Project but does not provide on-site labor.

Time for Completion: The number of consecutive calendar days following the issuance of the Notice to Proceed which the Contractor has to substantially complete all Work required by the Contract. When the Notice to Proceed is issued, it states a Contract Completion Date, which has been set by the Owner based on the Time for Completion.

Underground Facilities: All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels or other such facilities or attachments, and any encasements containing such facilities which are or have been installed underground to furnish any of the following services or materials: electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, sewage and drainage removal, traffic or other control systems or water.

Work: The services performed under this Contract including, but not limited to, furnishing labor, and furnishing and incorporating materials and equipment into the construction. The Work also includes the entire completed construction, or the various separately identifiable parts thereof, required to be furnished under the Contract Documents.

2. CONTRACT DOCUMENTS

(a) The Contract Between Owner and Contractor (CO-9), the Workers' Compensation Certificate of Coverage (CO-9a), the Standard Performance Bond (CO-10), the Standard Labor and Material Payment Bond (CO-10.1), the Schedule of Values and Certificate for Payment (CO-12), the Affidavit of Payments of Claims (CO-13), the Contractor's Certificate of Substantial Completion (CO-13.2a), and the Contractor's Certificate of Completion (CO-13.2) issued by the Commonwealth of Virginia in its Construction and Professional Services Manual are forms incorporated in these General Conditions by reference and are made a part hereof to the same extent as though fully set forth herein. They must be used by the Contractor for their respective purposes.

(b) All time limits stated in the Contract Documents, including but not limited to the Time for Completion of the Work, are of the essence of the Contract.

(c) The Contract Between Owner and Contractor shall be signed by the Owner and the Contractor in as many original counterparts as may be mutually agreed upon, each of which shall be considered an original.

(d) Anything called for by one of the Contract Documents and not called for by the others shall be of like effect as if required or called for by all, except that a provision clearly designed to negate or alter a provision contained in one or more of the other Contract Documents shall have the intended effect. In the event of conflicts among the Contract Documents, the Contract Documents shall take precedence in the following order: the Contract Between Owner and Contractor; the Supplemental General Conditions; the General Conditions; the Special Conditions; the specifications with attachments; and the plans.

(e) If any provision of this Contract shall be held invalid by any court of competent jurisdiction, such holding shall not invalidate any other provision.

(f) All correspondence, invoices, memoranda, submittals and other documents related to this Project whether generated by the Owner, the A/E, the Contractor or others should be identified at the beginning of the document with the eight digit (XXX-XXXXX) Project Code Number. Additional identification such as a job number, purchase order number or such may also be shown at the generator's option.

3. LAWS AND REGULATIONS

(a) The Contractor shall comply with all laws, ordinances, rules, regulations and lawful orders of any public authority bearing on the performance of the Work and shall give all notices required thereby. The Contractor shall assure that all Subcontractors and tradesmen who perform Work on the project are properly licensed by the Department of Professional and Occupational Regulation as required by Title 54.1, Chapter 11, Articles 1 and 3 and by applicable regulations.

(b) This Contract and all other contracts and subcontracts are subject to the provisions of Articles 3 and 5, Chapter 4, Title 40.1, Code of Virginia, relating to labor unions and the "right to work." The Contractor and its Subcontractors, whether residents or nonresidents of the Commonwealth, who perform any Work related to the Project shall comply with all of the said provisions.

(c) IMMIGRATION REFORM AND CONTROL ACT OF 1986: By signing this Contract, the Contractor certifies that it does not and will not during the performance of this Contract violate the provisions of the Federal Immigration Reform and Control Act of 1986, which prohibits employment of illegal aliens.

(d) The provisions of all rules and regulations governing safety as adopted by the Safety Codes Commission of the Commonwealth of Virginia and as issued by the Department of Labor and Industry under Title 40.1 of the Code of Virginia shall apply to all Work under this Contract. Inspectors from the Department of Labor and Industry shall be granted access to the Work for inspection without first obtaining a search or administrative warrant.

(e) Building Permit: Because this Project is on Commonwealth of Virginia property, codes or zoning ordinances of local political subdivisions do not apply to Work on the property. The Virginia Uniform Statewide Building Code applies to the Work and is administered by the Building Official for State-owned Buildings. The Building Permit will be obtained and paid for by the Owner. All other permits, local license fees, business fees, taxes, or similar assessments imposed by the appropriate political subdivision shall be obtained and paid for by the Contractor. See Section 25 for utility connection fees and services.

(f) The Contractor shall include in each of its subcontracts a provision requiring each Subcontractor to include or otherwise be subject to the same payment and interest requirements in Subsections (a), (b), and (c) of Section 37 of these General Conditions with respect to each lower-tier Subcontractor and Supplier.

(g) The Contractor, if not licensed as an asbestos abatement contractor in accordance with §54.1-514, Code of Virginia, shall have all asbestos-related Work performed by subcontractors who are duly licensed as asbestos contractors for the Work required.

(h) Lead Based Paint Activities: If the Contract Documents indicate that lead based paint is present on existing materials, components, or surfaces, the Contractor shall conform to the following:
(1) The requirements set forth in 59 Federal Register 45,872 (September 2, 1994) Proposed Rule) - *Lead; Requirements for Lead based Paint Activities (Proposed Rules)* in selecting and performing the means, methods and procedures for performing the Work. This includes, but is not limited to, training of personnel, lead abatement, encapsulation of lead containing materials, removal and handling of lead containing materials, and methods of disposal. When the Final Rule, to be codified at 40 CFR 745, supersedes the Proposed Rule, the Contractor shall be responsible for conforming to the Final Rule, as of the effective date set forth therein.
(2) The requirements for employee protection contained in 29 CFR Part 1926, Subpart D, and the requirements for record-keeping contained 29 CFR Part 1910.
(3) The Virginia Department of Labor and Industry's (DLI) Emergency Regulation published in the May 27, 1996 Virginia Register, requiring, among other things, that a permit be issued to the lead abatement contractor, or any subsequent regulation issued by DLI.

(i) If the Contractor violates laws or regulations that govern the Project, the Contractor shall indemnify and hold the Owner harmless against any fines and/or penalties that result from such violation. To the extent that such violation is the result of negligence or other actionable conduct of the Contractor, the Contractor shall indemnify and hold the Owner harmless against any third party claims, suits, awards, actions, causes of action or judgments, including but not limited to attorney's fees and costs incurred thereunder, that result from such violation.

(j) If the Work includes any land disturbing activities, the Contractor shall have on-site an individual certified by the Department of Conservation and Recreation as a Responsible Land Disturber in accordance with §10.1-563, Code of Virginia

4. NONDISCRIMINATION

(a) §2.2-4311 of the Code of Virginia shall be applicable. It provides as follows:

"1. During the performance of this Contract, the Contractor agrees as follows:

a. The Contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, disability, or other basis prohibited by state law relating to discrimination in employment, except where there is a bona fide occupational qualification reasonably necessary to the normal operation of the contractor. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.

b. The Contractor, in all solicitations or advertisements for employees placed by or on behalf of the contractor, will state that such Contractor is an equal opportunity employer.

c. Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting the requirements of this section.

2. The Contractor will include the provisions of the foregoing paragraphs a, b and c in every subcontract or purchase order of over $10,000, so that the provisions will be binding upon each subcontractor or vendor."

(b) Where applicable, the Virginians with Disabilities Act and the federal Americans with Disabilities Act shall apply to the Contractor and all Subcontractors.

5. PROHIBITION OF ALCOHOL AND OTHER DRUGS

(a) §2.2-4312 of the Code of Virginia shall be applicable. It provides as follows:

"During the performance of this contract, the contractor agrees to (i) provide a drug-free workplace for the contractor's employees; (ii) post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition; (iii) state in all solicitations or advertisements for employees placed by or on behalf of the contractor that the contractor maintains a drug-free workplace; and (iv) include the provisions of the foregoing clauses in every subcontract or purchase order of over $10,000, so that the provisions will be binding upon each subcontractor or vendor. For the purposes of this section, "drug-free workplace" means a site for the performance of work done in connection with a specific contract awarded to a contractor in accordance with this chapter, the employees of whom are prohibited from engaging in the unlawful manufacture, sale, distribution, dispensation, possession or use of any controlled substance or marijuana during the performance of the contract."

(b) The Contractor shall also establish, maintain and enforce policies which prohibit the following acts by all Contractor, Subcontractor and Supplier personnel at the Site:
(1) the manufacture, distribution, dispensation, possession, or use of alcohol, marijuana or other drugs, except possession and medically prescribed use of prescription drugs; and
(2) the impairment of judgment or physical abilities due to the use of alcohol, marijuana or other drugs, including impairment from prescription drugs.

6. TIME FOR COMPLETION

(a) The Time for Completion shall be designated by the Owner on the Invitation for Bids or other prebid documents. In some instances, the Time for Completion may be stated on the Invitation for Bids or other prebid document in the form of a Contract Completion Date. The Work must be substantially completed by the Time for Completion or the Contract Completion Date. Unless otherwise specified, the Contractor shall achieve Final Completion within thirty (30) days after the date of Substantial Completion.

(b) The Time for Completion shall be stated in the Contract Between Owner and Contractor and shall become a binding part of the Contract upon which the Owner may rely in planning the use of the facilities to be constructed and for all other purposes. If the Contractor fails to substantially complete the Work within the Time for Completion or Contract Completion Date, as set forth in the Contract, he shall be subject to payment of actual damages incurred by the Owner or liquidated damages, if provided for in the Contract.

(c) The Contractor, in submitting his bid, acknowledges that he has taken into consideration normal weather conditions. Normal weather does not mean statistically average weather, but rather means a range of weather patterns which might be anticipated based on weather data for the past ten (10) years, (i.e., conditions which are not extremely unusual). Normal weather conditions shall be determined from the public historical records available, including the U.S. Department of Commerce, Local Climatological Data Sheets, National Oceanic and Atmospheric Administration / Environmental Data and Information Service, National Climatic Center and National Weather Service. The data sheets to be used shall be those for the locality or localities closest to the site of the work. No additional compensation will be paid to the Contractor because of adverse weather conditions; however, an extension of time for abnormal weather will be considered by the Owner under the following conditions:
(1) The request for additional time shall be further substantiated by weather data collected during the period of delay at the Site. Said data must demonstrate that an actual departure from normal weather occurred at the Site during the dates in question.

(2) The extension requested must be supported by a delay in completion of the entire Project shown on the critical path of the accepted CPM Schedule or the approved bar graph schedule required for the Project. Extensions will be granted only for delays in completion of the Project, not for that portion of any delay which consumes only "float" time.

(3) A request for extension of time based on abnormal weather must be made in writing within five (5) calendar days of the completion of the calendar month during which abnormal weather is claimed at the Site.

(4) All of the evidence and data supporting the request (including both historical data and the recordings at the Site during the time of delay) must be furnished to the Owner before any consideration will be given to the request. That supporting data shall be submitted by the end of the calendar month following the month for which the request is made.

(d) The Contractor represents and agrees that he has taken into account in his bid the requirements of the bid documents, local conditions, availability of materials, equipment, and labor, and any other factors which may affect the performance of the Work. The Contractor agrees and warrants that he will achieve Substantial Completion of the Work to allow the Owner to have Beneficial Occupancy not later than the Time for Completion or Contract Completion Date. The Contractor agrees and warrants that he will achieve Final Completion of the Work (the entire completion of all Work, including "punch list" items), not later than thirty (30) days after achieving Substantial Completion.

7. CONDITIONS AT SITE

(a) The Contractor shall have visited the Site prior to bidding and is totally responsible for having ascertained pertinent local conditions such as location, accessibility and general character of the Site, and the character and extent of existing improvements and work within or adjacent to the Site. Claims, which result from the Contractor's failure to do so, will be deemed waived.

(b) If, in the performance of the Contract, hidden physical conditions of a building being modified are exposed revealing unusual or materially different conditions from those ordinarily encountered or inherent in work of this nature, or if subsurface or latent conditions at the Site are found which are materially different from those frequently present in the locality or from those indicated in the Contract Documents, the Contractor must report such conditions to the Owner and to the Architect/Engineer before the conditions are disturbed. Upon such notice, or upon his own observation of such conditions, the Architect/Engineer shall promptly propose such changes in the Contract Documents as he finds necessary to conform to the different conditions. Any change in the cost of the Work or additional time needed for completion must be requested pursuant to Sections 38, 39 and/or 43 of these General Conditions.

(c) If the Contractor, during the course of the Work, observes the existence of any material which he knows, should know, or has reason to believe is hazardous to human health, the Contractor shall promptly notify the Owner. The Owner will provide the Contractor with instructions regarding the disposition of the material. The Contractor shall not perform any Work involving the material or any Work causing the material to be less accessible prior to receipt of special instructions from the Owner.

8. CONTRACT SECURITY

(a) For contracts with a value exceeding one hundred thousand dollars ($100,000), the Contractor shall deliver to the Owner or its designated representative, a Commonwealth of Virginia Standard Performance Bond, DGS-30-084 (Form CO-10) and a Commonwealth of Virginia Standard Labor and Material Payment Bond, DGS-30-088 (Form CO-10.1) each fully executed by the Contractor and one or more surety companies legally licensed to do business in Virginia and each in an amount equal to one hundred percent (100%) of the accepted bid. If more than one Surety executes a bond, each shall be jointly and severally liable to the Owner for the entire amount of the bond. Sureties shall be selected by the Contractor, subject to approval by the Owner. No payment on the Contract shall be due and payable to the Contractor until the bonds have been approved by the Owner and the Office of the Attorney General of Virginia. In order to facilitate review of the bonds by the Office of the Attorney General, the power of attorney from the surety company to its agent who executes the bond shall be attached to the bond, or, prior to the execution of the bonds by the surety, recorded in the Office of the Clerk of Court for the City of Richmond, Virginia, at the John Marshall Court Building, 400 North Ninth Street, except when the Owner is one of the following, in which case the power of attorney must be recorded with the Clerk of Court in the place shown:

OWNER	PLACE OF RECORDATION
University of Virginia	City of Charlottesville
Old Dominion University	City of Norfolk
Norfolk State University	City of Norfolk
Christopher Newport University	City of Newport News
Virginia Polytechnic Institute And State University	County of Montgomery

(b) For the purposes of all Standard Labor and Material Payment Bonds entered into, the term "subcontractors" as used in §2.2-4337.A.2. of the Code of Virginia is interpreted to mean any contractors who participated in the prosecution of the Work undertaken by the Contractor (referred to in §2.2-4337. A.2. of the Code of Virginia as the "prime contractor"), whether such contractor had a direct contract with the Contractor (prime contractor) or whether there were one or more other intervening Subcontractors contractually positioned between it and the Contractor (prime contractor).

(c) See §2.2-4338 of the Code of Virginia, for alternative forms of security for payment and/or performance bonds.

(d) For contracts with a value of less than one hundred thousand dollars ($100,000), the Contractor will not be required to provide a Standard Performance Bond and a Standard Labor and Material Payment Bond as described above **unless** the Invitation for Bid states that such bonds will be required.

9. SUBCONTRACTS

(a) The Contractor shall, as soon as practicable after the signing of the Contract, notify the Owner and Architect/Engineer in writing of the names of all Subcontractors proposed for the principal parts of the Work and of such others as the Architect/Engineer may direct. Where the specifications establish qualifications or criteria for Subcontractors, manufacturers, or individuals performing Work on the Project, the Contractor shall be responsible for ascertaining that those proposed meet the criteria or qualifications. The Contractor shall not employ any Subcontractor that the Owner may, within a reasonable time, object to as unsuitable. Neither the Owner nor the Architect/Engineer shall direct the Contractor to contract with any particular Subcontractor unless provided in the specifications or Invitation for Bids.

(b) The Owner may select a particular Subcontractor for a certain part of the Work and designate on the Invitation for Bids that the Subcontractor shall be used for the part of the Work indicated and that the Subcontractor has agreed to perform the Work for the subcontract amount stipulated on the bid form.

The Contractor shall include the stipulated amount plus his Contractor markups in the bid. In such case, the Contractor shall be responsible for that Subcontractor and its work and the Subcontractor shall be responsible to the Contractor for its work just as if the Contractor had selected the Subcontractor.

(c) The Owner shall, on request, furnish to any Subcontractor, if practicable, the amounts of payments made to the Contractor, the Schedule of Values and Requests for Payment submitted by the Contractor and any other documentation submitted by the Contractor which would tend to show what amounts are due and payable by the Contractor to the Subcontractor.

(d) The Contractor shall be fully responsible to the Owner for all acts and omissions of his agents and employees and all succeeding tiers of Subcontractors and Suppliers performing or furnishing any of the Work. Nothing in the Contract Documents shall create any contractual relationship between Owner or Architect/Engineer and any such Subcontractor, Supplier or other person or organization, nor shall it create any obligation on the part of Owner or Architect/Engineer to pay for or to see to the payment of any moneys due any such Subcontractor, Supplier or other person or organization, except as may otherwise be required by law.

(e) The Contractor shall be fully responsible for his invitees at the Site and for those of his Subcontractors, Suppliers, and their employees, including any acts or omissions of such invitees.

(f) The Contractor agrees that he alone is responsible for all dealings with his Subcontractors and Suppliers, and their subcontractors, employees and invitees, including, but not limited to, the Subcontractors' or Suppliers' claims, demands, actions, disputes and similar matters unless specifically provided otherwise by the Contract or by statute.

10. SEPARATE CONTRACTS

(a) The Owner reserves the right to let other contracts in connection with the Project, the Work under which may proceed simultaneously with the execution of this Contract. The Contractor shall afford other separate contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work. The Contractor shall cooperate with them and shall take all reasonable action to coordinate his Work with theirs. If the Owner has listed other separate contracts in the Invitation for Bids which it expects to proceed simultaneously with the Work of the Contractor, and has included the estimated timing of such other Contracts in the Invitation for Bids, the Contractor shall integrate the schedule of those separate contracts into his scheduling. The Contractor shall make every reasonable effort to assist the Owner in maintaining the schedule for all separate contracts. If the work performed by the separate contractor is defective or performed so as to prevent or threaten to prevent the Contractor from carrying out his Work according to the Contract, the Contractor shall immediately notify the Owner and the Architect/Engineer upon discovering such conditions.

(b) If a dispute arises between the Contractor and any separate contractor(s) as to their responsibility for cleaning up as required by Sections 31 (c) and 31 (d) of these General Conditions, the Owner may clean up and charge the cost thereof to the respective contractors in proportion to their responsibility. If a Contractor disputes the Owner's apportionment of clean-up costs, it shall be that contractor's burden to demonstrate and prove the correct apportionment.

11. CONTRACTOR'S AND SUBCONTRACTOR'S INSURANCE

(a) The Contractor shall not commence Work under this Contract until he has obtained all the insurance required hereunder from an insurer authorized to do business in Virginia and such insurance has been approved by the Owner; nor shall the Contractor allow any Subcontractor to commence Work on his subcontract until the same types of insurance in an appropriate amount have been obtained by the Subcontractor and approved by the Contractor. Approval of insurance by the Owner shall not relieve or decrease the liability of the Contractor hereunder.

(b) The Contractor shall take out, and shall maintain in force at all times during the performance of the Work, Workers' Compensation and Employers' Liability Insurance for all of his employees engaged in the Work in an amount not less than the minimum required by §2.2-4332 and §65.2-100 et seq. of the Code of Virginia. In case any of the Work is sublet, the Contractor shall require each Subcontractor similarly to provide Workers' Compensation and Employers' Liability Insurance for all of the latter's employees to be engaged in the Work. Prior to award of the Contract, the Contractor shall submit on the form provided by the Owner, a Certificate of Coverage verifying Workers' Compensation coverage. The Contractor shall likewise obtain a Certificate of Coverage for Workers' Compensation coverage from each subcontractor prior to awarding the subcontract and shall provide a copy to the Owner.

(c) During the performance of the Work under this Contract, the Contractor shall maintain commercial general liability insurance to include Premises / Operations Liability, Products and Completed Operations Coverage, Independent Contractor's Liability, Owner's and Contractor's Protective Liability, and Personal Injury Liability, which shall insure him against claims of personal injury, including death, as well as against claims for property damage, which may arise from operations under this Contract, whether such operations be by himself or by any Subcontractor, or by anyone directly or indirectly employed by either of them. The amounts of general liability insurance shall be not less than **$1,000,000** per occurrence and **$2,000,000** aggregate combined limit. The Commonwealth of Virginia, its officers, employees and agents, shall be named as an additional insured with respect to the Work being procured. The Supplemental General Conditions may require the Contractor to provide an Umbrella insurance policy in a specified amount for the Project.

(d) During the performance of the Work under this Contract, the Contractor shall maintain automobile liability insurance which shall insure him against claims of personal injury, including death, as well as against claims for property damage, which may arise from operations under this Contract, whether such operations be by himself or by any Subcontractor, or by anyone directly or indirectly employed by either of them. The amounts of automobile insurance shall be not less than **$1,000,000** combined limit for bodily injury and property damage per occurrence.

(e) The Asbestos Contractor or Subcontractor, as the case may be, shall provide occurrence-based liability insurance with asbestos coverages in an amount not less than **$1,000,000** and shall name the following as additional insureds: The Commonwealth of Virginia, its officers, its employees and its agents; the Architect/Engineer (if not the Asbestos Project Designer); and the Contractor (where the asbestos work is being performed by the Asbestos Subcontractor).

12. "ALL RISK" BUILDER'S RISK INSURANCE

(a) The Contractor, at his cost, shall obtain and maintain in the names of the Owner and the Contractor "all-risk" builder's risk insurance (or fire, extended coverage, vandalism and malicious mischief insurance, if approved by the Owner and the Director, Division of Engineering and Buildings) upon the entire structure or structures on which the Work of this Contract is to be done and upon all material in or adjacent thereto which is intended for use thereon, to one hundred

percent (100%) of the insurable value thereof. Such insurance may include a deductible provision if the Owner so provides in the Supplemental General Conditions, in which case the Contractor will be liable for such deductions, whenever a claim arises. The loss, if any, is to be made adjustable with and payable to the Owner, in accordance with its interests, as they may appear. The Owner, its officers, employees and its agents, shall be named as an additional insured in any policy of insurance issued. Written evidence of the insurance shall be filed with the Owner no later than thirty (30) days following the award of the Contract. In the event of cancellation of this insurance, not less than thirty (30) days prior written notice must be sent to the Owner. A copy of the policy of insurance shall be given to the Owner upon demand.

(b) The value of the builder's risk insurance shall exclude the costs of excavations, backfills, foundations, underground utilities and Sitework.

(c) The Owner maintains insurance coverage on its buildings. On reroofing, renovation, and interior modifications of existing building projects where the Owner continues to occupy the building, or a portion thereof, while the Work is being performed, the Contractor shall provide "all risk" builders risk insurance, as describe above, in an amount equal to one hundred percent (100%) of the Contract Price for the Work. In those instances, the Supplemental General Conditions for the project shall expressly exclude the project from the requirements of Subsection 12(a). The Contractor is responsible for providing any desired coverage for Contractor's or Subcontractors' buildings, equipment, materials, tools or supplies that are on-site.

(d) Any insurance provided through the Department of Treasury, Division of Risk Management, on buildings, construction, additions or renovations will not extend to Contractor's nor Subcontractors' buildings, equipment, materials, tools or supplies unless these items are to become property of the Owner upon completion of the Project and the Owner has assumed responsibility for such items at the time of the loss.

13. TAXES, FEES AND ASSESSMENTS

The Contractor shall, without additional expense to the Owner, pay all applicable federal, state, and local taxes, fees, and assessments except the taxes, fees and assessments on the real property comprising the Site of the project. If the State Building Official elects to have the local building official inspect the Work as provided by §36-98.1 of the Code of Virginia, the Owner shall pay the resulting fees to the local building official.

14. PATENTS

The Contractor shall obtain all licenses necessary to use any invention, article, appliance, process or technique of whatever kind and shall pay all royalties and license fees. The Contractor shall hold the Owner, its officers, agents and employees, harmless against any loss or liability for or on account of the infringement of any patent rights in connection with any invention, process, technique, article or appliance manufactured or used in the performance of the Contract, including its use by the Owner, unless such invention, process, technique, article or appliance is specifically named in the specifications or plans as acceptable for use in carrying out the Work. If, before using any invention, process, technique, article or appliance specifically named in the specifications or plans as acceptable for use in carrying out the Work, the Contractor has or acquires information that the same is covered by letters of patent making it necessary to secure the permission of the patentee, or other, for the use of the same, he shall promptly advise the Owner and the Architect/Engineer. The Owner may direct that some other invention, process, technique, article or appliance be used. Should the Contractor have reason to believe that the invention, process, technique, article or appliance so specified is an infringement of a patent, and fail to inform the Owner and the Architect/Engineer, he shall be responsible for any loss or liability due to the infringement.

15. ARCHITECT/ENGINEER'S STATUS

(a) The Architect/Engineer shall have authority to endeavor to secure the faithful performance by Owner and Contractor of the Work under the Contract. He shall review the Contractor's Submittals for conformance to the requirements of the Contract Documents and return copies to the Contractor with appropriate notations. He shall interpret the requirements of the plans and specifications and issue Field Orders to the Contractor as may be required. He shall recommend to the Owner suspension of the Work (in whole or in part) whenever such suspension may be necessary to ensure the proper execution of the Contract. He shall have authority to reject, in writing, Work, including material, installation or workmanship, which does not conform to the requirements of the plans and specifications. He shall determine the progress and quality of the Work, subject to the right of the Owner to make an overriding decision to the contrary. Upon request by the Contractor, the Architect/Engineer shall confirm, in writing within ten (10) days, any oral order or determination made by him.

(b) The Architect/Engineer shall have no authority to approve or order changes in the Work which alter the design concept or which call for an extension of time or a change in the Contract Price.

(c) Although the Owner is bound by the terms of the Contract with the Contractor, including the plans and specifications, the Owner shall have the right, but not the duty, to countermand any decision of the Architect/Engineer and to follow or reject the advice of the Architect/Engineer, including but not limited to acceptance of the Work, as it deems best. In those instances where the Architect/Engineer has been given authority to act, the Architect/Engineer shall promptly do so, but in the case of disagreement between the Architect/Engineer and the Owner, the decision of the Owner shall be final. The Contractor shall not be bound by any determination, interpretation or decision of the Architect/Engineer, if it is later determined that the same is not in accord with the Contract Documents. The party taking issue with the determination, interpretation or decision of the Architect/Engineer shall give the other party written notice of such fact within ten (10) days after the determination, interpretation or decision is communicated by the Architect/Engineer. In the actual performance of the Work, however, the Contractor shall, in the first instance, proceed in accordance with instructions given by the Architect/Engineer unless the Owner and the Contractor mutually agree that the Contractor shall proceed otherwise.

(d) All orders from the Owner to the Contractor shall either be transmitted through the Architect/Engineer or communicated directly to the Contractor and the Architect / Engineer by the Owner.

(e) Should the Owner choose to employ another or different Architect / Engineer, the status of the Architect/Engineer so employed shall be the same as that of the former Architect/Engineer.

(f) The Architect/Engineer will provide to the Owner and the Contractor after each visit to the Site, a written report indicating the date, time of day, weather conditions and the names of the persons representing the Architect/Engineer who participated in the visit. The report will advise the Owner of any problems that were noted and shall compare the Architect/Engineer's observations of the actual progress of the Work with that reported by the Contractor. On the basis of his on-Site observations as Architect/Engineer, he will make every reasonable effort to guard the Owner against defects and deficiencies in the Work of the Contractor. He shall have the authority to inspect the Work, to note and report Defective Work and deviations from the Contract Documents to the Owner, to reject same, and to recommend to the Owner the suspension of the Work when necessary to prevent Defective Work from proceeding or being covered.

(g) The Architect/Engineer shall not be responsible for construction means, methods, techniques, sequences or procedures (other than those expressly specified in Contract Documents), or for safety precautions and programs in connection with the Work, and he shall not be responsible for the Contractor's failure to carry out the Contractor's own responsibilities.

(h) The Architect/Engineer generally conveys written decisions and notices to the Contractor through the Project Manager and shall generally receive information and Notices from the Contractor through the Project Manager unless otherwise agreed. The Owner may delegate from the Architect/Engineer to the Project Manager certain inspection, verification, acceptance, rejection, and administrative duties and authority, but any such delegation shall be in writing and a copy thereof provided to the Contractor.

(i) The provisions of this section are included as information only to describe the relationship between the Owner, A/E, and Contractor. No failure of the A/E to act in accordance with this section shall relieve the Contractor from his obligations under the Contract or create any rights in favor of the Contractor.

16. INSPECTION

(a) All material and workmanship shall be subject to inspection, examination and testing by the Owner, the Architect/Engineer, the Project Inspector, authorized inspectors and authorized independent testing entities at any and all times during manufacture and/or construction. The Architect/Engineer and the Owner shall have authority to reject defective material and workmanship and require its correction. Rejected workmanship shall be satisfactorily corrected and rejected material shall be satisfactorily replaced with proper material without charge therefor, and the Contractor shall promptly segregate and remove the rejected material from the Site. If the Contractor fails to proceed at once with replacement of rejected material and/or the correction of defective workmanship, the Owner may, by contract or otherwise, replace such material and/or correct such workmanship and charge the cost to the Contractor, or may terminate the right of the Contractor to proceed as provided in Section 41 of these General Conditions, the Contractor and surety being liable for any damage to the same extent as provided in Section 41 for termination thereunder.

(b) Site inspections, tests conducted on Site or tests of materials gathered on Site, which the Contract requires to be performed by independent testing entities, shall be contracted and paid for by the Owner. Examples of such tests are the testing of cast-in-place concrete, foundation materials, soil compaction, pile installations, caisson bearings and steel framing connections. The Contractor shall promptly furnish, without additional charge, all reasonable facilities, labor and materials necessary and convenient for making such tests. Except as provided in (d) below, whenever such examination and testing finds defective materials, equipment or workmanship, the Contractor shall reimburse the Owner for the cost of reexamination and retesting. Although conducted by independent testing entities, the Owner will not contract and pay for tests or certifications of materials, manufactured products or assemblies which the Contract, codes, standards, etc., require to be tested and/or certified for compliance with industry standards such as Underwriters Laboratories, Factory Mutual or ASTM. If fees are charged for such tests and certifications, they shall be paid by the Contractor. The Contractor shall also pay for all inspections, tests, and certifications which the Contract specifically requires him to perform or to pay, together with any inspections and tests which he chooses to perform for his own purposes, but are not required by the Contract.

(c) Where Work is related to or dependent on the Defective Work, the Contractor shall stop such related or dependent Work until the Defective Work or deficiency is corrected or an alternative solution is presented that is satisfactory to the Owner. Where Work is rejected because of defective material or workmanship, the Contractor shall stop like Work in other areas or locations on the Project until the matter is resolved and the Owner has approved corrective measures.

(d) Should it be considered necessary or advisable by Owner or the Architect/Engineer at any time before final acceptance of the entire Work to make an examination of any part of the Work already completed, by removing or tearing out portions of the Work, the Contractor shall on request promptly furnish all necessary facilities, labor and material to expose the Work to be tested to the extent required. If such Work is found to be defective in any respect, due to the fault of the Contractor or his Subcontractors, the Contractor shall defray all the expenses of uncovering the Work, of examination and testing, and of satisfactory reconstruction. If, however, such Work is found to meet the requirements of the Contract, the actual cost of the Contractor's labor and material necessarily involved in uncovering the Work, the cost of examination and testing, and Contractor's cost of material and labor necessary for replacement including a markup of fifteen (15%) percent for overhead and profit shall be paid to the Contractor and he shall, in addition, if completion of the Work has been delayed thereby, be granted a suitable extension of time. Notwithstanding the foregoing, the Contractor shall be responsible for all costs and

expenses in removing and replacing the Work if the Contractor had covered the Work prior to any inspection or test contrary to the instructions of the A/E, Owner or Project Inspector.

(e) The Project Inspector has the authority to recommend to the Architect/Engineer and the Owner that the Work be suspended when in his judgment the Contract Documents are not being followed. Any such suspension shall be continued only until the matter in question is resolved to the satisfaction of the Owner. The cost of any such Work stoppage shall be borne by the Contractor unless it is later determined that no fault existed in the Contractor's Work.

(f) The Project Inspector has the right and the authority to:

(1) Inspect all construction materials, equipment, and supplies for quality and for compliance with the Contract Documents and/or approved shop drawings and Submittals.

(2) Inspect workmanship for compliance with the standards described in the Contract Documents.

(3) Observe and report on all tests and inspections performed by the Contractor.

(4) Recommend rejection of Work which does not conform to requirements of the Contract Documents.

(5) Keep a record of construction activities, tests, inspections, and reports.

(6) Attend all joint Site construction meetings and inspections held by the Owner and/or the A/E with the Contractor.

(7) Check materials and equipment, together with documentation related thereto, delivered for conformance with approved Submittals and the Contract.

(8) Check installations for proper workmanship and conformance with shop drawing and installation instructions.

(9) Assist in the review and verification of the CO-12, Schedule of Values & Certificate for Payment, submitted by the Contractor each month.

(10) Do all things for or on behalf of the Owner as the Owner may subsequently direct in writing.

(g) The Project Inspector has no authority to:

(1) Authorize deviations from the Contract Documents;

(2) Enter into the area of responsibility of the Contractor's superintendent;

(3) Issue directions relative to any aspect of construction means, methods, techniques, sequences or procedures, or in regard to safety precautions and programs in connection with the Work;

(4) Authorize or suggest that the Owner occupy the Project, in whole or in part; or

(5) Issue a certificate for payment.

(h) The duties of the Project Inspector are for the benefit of the Owner only and not for the Contractor. The Contractor may not rely upon any act, statement, or failure to act on the part of the Project Inspector, nor shall the failure of the Project Inspector to properly perform his duties in any way excuse Defective Work or otherwise improper performance of the Contract by the Contractor.

17. SUPERINTENDENCE BY CONTRACTOR

(a) The Contractor shall have a competent foreman or superintendent, satisfactory to the Architect/Engineer and the Owner, on the Site at all times during the progress of the Work. The superintendent or foreman

shall be familiar with and be able to read and understand the plans and specifications, and be capable of communicating orally and in writing with the Owner's inspectors and the Contractor's workers. The Contractor shall be responsible for all construction means, methods, techniques, sequences and procedures, for coordinating all portions of the Work under the Contract except where otherwise specified in the Contract Documents, and for all safety and worker health programs and practices. The Contractor shall notify the Owner, in writing, of any proposed change in superintendent, including the reason therefor, prior to making such change.

(b) The Contractor shall, at all times, enforce strict discipline and good order among the workers on the Project, and shall not employ on the Work, or contract with, any unfit person, anyone not skilled in the Work assigned to him, or anyone who will not work in harmony with those employed by the Contractor, the Subcontractors, the Owner or the Owner's separate contractors and their subcontractors.

(c) The Owner may, in writing, require the Contractor to remove from the Site any employee or Subcontractor's employee the Owner deems to be incompetent, careless, not working in harmony with others on the Site, or otherwise objectionable, but the Owner shall have no obligation to do so.

18. CONSTRUCTION SUPERVISION, METHODS AND PROCEDURES

(a) The Contractor shall be solely responsible for supervising and directing the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract. The Contractor shall be solely responsible for the means, methods, techniques, sequences and procedures of construction and for coordinating all portions of the Work under the Contract, except where otherwise specified in the Contract Documents. However, the Contractor shall not be responsible for the negligence of others in the design or selection of a specific means, method, technique, sequence or procedure of construction which is indicated in and required by the Contract. The Contractor is solely responsible to the Owner that the finished Work complies with the Contract Documents.

The Contractor shall be solely responsible for health and safety precautions and programs for workers and others in connection with the Work. No inspection by, knowledge on the part of, or acquiescence by the Architect or Engineer, the Project Inspector, the Owner, the Owner's employees and agents, or any other entity whatever shall relieve the Contractor from its sole responsibility for compliance with the requirements of the Contract or its sole responsibility for health and safety programs and precautions.

(b) If a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents, the Contractor may furnish or utilize a substitute means, method, sequence, technique or procedure of construction acceptable to Architect/Engineer, subject to the Owner's right to disapprove. The Contractor must submit its written request for the substitution to the Architect/Engineer with sufficient information to allow the Architect/Engineer to determine that the substitute proposed is equivalent to that indicated or required by the Contract.

(c) The divisions and sections of the Specifications and the identification of any drawings shall not control the Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

19. SCHEDULE OF THE WORK

(a) **General:** The Contractor is responsible for the scheduling and sequencing of the Work, for coordinating the Work, for monitoring the progress of the Work, and for taking appropriate action to keep the Work on schedule. The Contractor may attempt to achieve Substantial Completion on or before the Time for Completion or the Contract Completion Date established by the Contract and receive payment in accordance with Section 36 for the Work completed each period. However, the date established by the Contract Documents as the deadline for achieving Substantial Completion must be used in all schedules as the date on which Substantial Completion will be achieved. The time (in days) between the Contractor's planned early completion and the contracted Time for Completion is part of the Project "Total Float" time and will be used as such. Extensions of time pursuant to

Sections 38, 39, and 43, damages for delay, and all other matters between the Owner and the Contractor will be determined using the contractually required Substantial Completion date, not an early Substantial Completion date planned by the Contractor.

Within two (2) weeks after the Contractor signs the Contract Between Owner and Contractor, unless otherwise extended by the Owner at the time of the signing, the Contractor shall prepare and submit to the Owner, with a copy to the Architect/Engineer, a preliminary bar graph schedule for accomplishing the Work based upon the Time for Completion stated in the Contract. The preliminary bar graph schedule shall be in sufficient detail to show the sequencing of the various trades for each floor level, wing or work area. The Owner will notify the Contractor of its acceptance of or objections to the preliminary schedule within fifteen (15) days of receipt by the Owner. A fully complete Project schedule for accomplishing the Work must be submitted in like manner no later than sixty (60) days after the Contract is signed by the Owner.

The Owner's failure to reject or its acceptance of any schedule, graph, chart, recovery schedule, updated schedule, plan of action, etc. shall not constitute a representation or warranty by the Owner, including but not limited to a representation or warranty that the schedule is feasible or practical nor shall any such acceptance or failure to reject relieve the Contractor from sole responsibility for completing the Work within the time allowed.

No progress payments will be payable to the Contractor until after it has submitted a preliminary schedule which is acceptable to the Owner. Neither the second progress payment nor any subsequent payment shall be payable to the Contractor until it has submitted a fully complete Project schedule accepted by the Owner. Nor shall subsequent progress payments be payable to the Contractor unless and until he maintains the monthly bar graphs or status reports required by Section 19(d) herein or unless and until he provides any recovery schedule pursuant to Section 19(e) herein.

Failure to provide a satisfactory preliminary or fully complete Project schedule within the time limits stated above shall be a breach of contract for which the Owner may terminate the Contract in the manner provided in Section 41 of these General Conditions.

The fully complete Project schedule for accomplishing the Work shall be of the type set forth in subparagraph (1) or (2) below, as appropriate:

(1) For Contracts with a price of $1,500,000 or less, a bar graph schedule will satisfy the above requirement. The schedule shall indicate the estimated starting and completion dates for each major element of the work. See (b) below.

(2) For Contracts with a price over $1,500,000, a Critical Path Method (CPM) schedule shall be utilized to control the planning and scheduling of the Work. The CPM schedule shall be the responsibility of the Contractor and shall be paid for by the Contractor. See (c) below.

(b) **Bar Graph Schedule:** Where a bar graph schedule is required, it shall be time-scaled in weekly increments, shall indicate the estimated starting and completion dates for each major element of the Work by trade and by area, level, or zone, and shall schedule dates for all salient features, including but not limited to the placing of orders for materials, submission of shop drawings and other Submittals for approval, approval of shop drawings by Architect/Engineer, the manufacture and delivery of material, the testing and the installation of materials, supplies and equipment, and all Work activities to be performed by the Contractor.

The Contractor shall allow sufficient time in his schedule for the A/E to conduct whatever associated reviews or inspections as may be required under the A/E's contract with the Owner. If the A/E and the Contractor are unable to agree as to what constitutes sufficient time, the Owner shall determine the appropriate duration for such Architect/Engineer activities. Each Work activity will be assigned a time estimate by the Contractor. One day shall be the smallest time unit used.

It is the Contractor's responsibility to submit a schedule that shows Substantial Completion of the Work by the Contract Time for Completion or the Contract Completion Date and any interim deadlines established by the Contract.

(c) **CPM Schedule:** Where a CPM schedule is required, it shall be in the time-scaled precedence format using the Contractor's logic and time estimates. The CPM schedule shall be drawn or plotted with activities grouped or zoned by Work area or subcontract as opposed to a random (or scattered) format.

The CPM schedule shall be time-scaled on a weekly basis and shall be drawn or plotted at a level of detail and logic which will schedule all salient features of the Work, including not only the actual construction Work for each trade, but also the submission of shop drawings and other Submittals for approval, approval of shop drawings by Architect/Engineer, placing of orders for materials, the manufacture and delivery of materials, the testing and installation of materials and equipment, and all Work activities to be performed by the Contractor. Failure to include any element of Work required for the performance of this Contract shall not excuse the Contractor from completing all Work required within the Time for Completion, Contract Completion Date and any interim deadlines established by the Contract.

The Contractor shall allow sufficient time in his schedule for the A/E to conduct whatever associated reviews or inspections as may be required under the A/E's contract with the Owner. If the A/E and the Contractor are unable to agree as to what constitutes sufficient time, the Owner shall determine the appropriate duration for such Architect/Engineer activities. Each Work activity will be assigned a time estimate by the Contractor. One day shall be the smallest time unit used.

It is the Contractor's responsibility to submit a schedule that shows Substantial Completion of the Work by the Contract Time for Completion or the Contract Completion Date and any interim deadlines established by the Contract.

When completed, the CPM schedule shall be submitted to the Architect/Engineer and the Owner for review. The CPM schedule will identify and describe each activity, state the duration of each activity, the calendar dates for the early and late start and the early and late finish of each activity, and clearly highlight all activities on the critical path. "Total float" and "free float" shall be indicated for all activities. Float time, whether "free float" or "total float" as defined in Section 1, shall not be considered for the exclusive use or benefit of either the Owner or the Contractor, but must be allocated in the best interest of completing the Work within the Time for Completion or the Contract Completion Date. Extensions to the Time for Completion or the Contract Completion Date, when granted by Change Order, will be granted only when equitable time adjustment exceeds the Total Float in the activity or path of activities affected by the change. On contracts with a price over $5,000,000, the CPM schedule shall also show what part of the Contract Price (expressed in U.S. dollars) is attributable to each activity on the schedule, the sum of which for all activities shall equal the total Contract Price. On contracts with a price over $10,000,000, the CPM schedule shall also show the planned workforce (crew size and number of crews) and the major pieces of equipment required for each activity on the schedule. When acceptable to the Owner and Architect/Engineer as to compliance with the requirements of this Section, but not as to logic, the schedule shall become the CPM schedule for the Project. Acceptance of the schedule by the Owner does not indicate agreement with nor responsibility for the proposed or actual duration of any activity shown on the accepted schedule.

(d) **Monthly Project Reports:** The Contractor shall review progress not less than each month, but as often as necessary to properly manage the Project and stay on schedule. The Contractor shall collect and preserve information on Change Orders, including extensions of time. The Contractor shall evaluate this information and update the latest accepted schedule as often as necessary to finish within the Contract Time for Completion or before the Contract Completion Date. The Contractor shall submit to the A/E along with his monthly request for payment a copy of the bar graph schedule annotated to show the current progress. For projects requiring a CPM schedule, the Contractor shall submit a monthly report of the status of all activities. The bar graph schedule or monthly status report submitted with each periodic request for payment shall show the Work completed to date in comparison with the Work scheduled for completion, including but not limited to the dates for the beginning and completion of the placing of orders; the manufacture, testing and installation of materials, supplies and equipment. The form shall be approved by the A/E and the Owner; however, a bar graph or a CPM schedule marked, colored or annotated to reflect the above will usually satisfy this requirement. If any elements of the Work are behind schedule, regardless of whether they may prevent the Work from being completed on time, the Contractor must indicate in writing in the report what measures he is taking and plans to take to bring each such element back on schedule and to ensure that the Time for Completion or Contract Completion Date is not exceeded.

(e) **Progress Delay:** Should any of the following conditions exist, the Owner may require the Contractor to prepare, at no extra cost to the Owner, a plan of action and a recovery schedule for completing the Work by the Contract Time for Completion or the Contract Completion Date:

(1) The Contractor's monthly progress report indicates delays that are, in the opinion of the A/E or the Owner, of sufficient magnitude that the Contractor's ability to complete the Work by the scheduled Time for Completion or the Contract Completion Date is brought into question;

(2) The CPM schedule sorted by early finish shows the Contractor to be thirty (30) or more days behind the critical path schedule at any time during construction up to thirty (30) days prior to scheduled Substantial Completion date;

(3) The Contractor desires to make changes in the logic (sequencing of Work) or the planned duration of future activities of the CPM schedule which, in the opinion of the Architect/Engineer or the Owner, are of a major nature.

The plan of action and recovery schedule, when required, shall explain and display how the Contractor intends to regain compliance with the current accepted, fully completed, Project CPM schedule, as updated by approved change orders.

The plan of action, when required, shall be submitted to the Owner for review within two (2) business days of the Contractor receiving the Owner's written demand. The recovery schedule, when required, shall be submitted to the Owner within five (5) calendar days of the Contractor's receiving the Owner's written demand.

(f) **Early Completion of Project:** The Contractor may attempt to achieve Substantial Completion on or before the Time for Completion or the Contract Completion Date. However, such planned early completion shall be for the Contractor's convenience only and shall not create any additional rights of the Contractor or obligations of the Owner under this Contract, nor shall it change the Time for Completion or the Contract Completion Date. The Contractor shall not be required to pay damages to the Owner because of its failure to achieve Substantial Completion by its planned earlier date. Likewise, the Owner shall not pay the Contractor any additional compensation for achieving Substantial Completion early nor will the Owner owe the Contractor any compensation should the Owner, its officers, employees, or agents cause the Contractor not to achieve Substantial Completion earlier than the date required by the Contract Documents.

If the Contractor seeks to change the Time for Completion or the Contract Completion Date to reflect an earlier completion date, he may request or propose such a change. The Owner may, but is not required to, accept such proposal. However, a change in the the Time for Completion or the Contract Completion Date shall be accomplished only by Change Order. If the Contractor's proposal to change the Time for Completion or the Contract Completion Date is accepted, a Change Order will be issued stating that all references in the Contract, including these General Conditions, to the Time for Completion or the Contract Completion Date shall thereafter refer to the date as modified, and all rights and obligations, including the Contractor's liability for actual damages, delay damages and/or liquidated damages, shall be determined in relation to the date, as modified.

20. SCHEDULE OF VALUES AND CERTIFICATE FOR PAYMENT

(a) Before submittal of the first partial payment request under the Contract, the Contractor shall prepare for review and approval of the Architect/Engineer and the Owner, a schedule of the estimated values listed by trades or by specification sections of the Work, totaling the Contract Price. Where the total project has multiple parts or phases, the Contractor shall prepare appropriate schedules of values to facilitate reviews and justifications for payments.

All requests for payment shall be made on the Schedule of Values and Certificate for Payment (Form CO-12) pages 1 and 2. Succeeding pages may be on the Form CO-12 continuation sheets or a computerized spreadsheet which is in the same format and which contains the same information. Where a computerized spreadsheet is used, one copy of the entire Schedule of Values shall be provided to the Owner on diskette in a spreadsheet format (e.g. LOTUS, EXCEL, or QUATTRO PRO) with the initial request for payment.

(b) If the Contractor requests, or intends to request, payment for materials stored in an approved and secure manner, the Schedule of Values must indicate the amount for labor and the amount for materials, and in a supplement thereto must include an itemized list of materials for that trade or Work section. The material breakdown shall be in sufficient detail to allow verification of the

quantities required for the Project, the quantities delivered, the Work completed, and the quantities stored on or off Site.

(c) The "Value of Work Completed" portion of the Form CO-12 shall be completed, the Contractor's certification completed and signed, and the appropriate substantiating material attached to each Certificate for Payment (CO-12). Such substantiating material includes, but is not limited to, invoices for materials, delivery tickets, time sheets, payroll records, daily job logs/records, and similar materials which, in the opinion of the Owner and the A/E, are necessary or sufficient to justify payment of the amount requested.

(d) The labor progress for any task or activity shall be calculated based upon the percentage of Work complete up to fifty percent (50%) of the completion of the task or activity. Thereafter, the evaluation of labor progress will be based upon the effort required to complete that task or activity. The material progress shall be calculated as the invoiced dollar cost of materials used in relationship to the amount estimated as necessary to complete a particular element of Work. When calculating material progress, credit shall be given for installed material as well as that stored on the Site and any material stored off Site which has been certified by the Architect/Engineer in accordance with Section 36 of these General Conditions.

(e) Should Work included in previous Form CO-12 submittals, and for which payment has been made, subsequently be identified, by tests, inspection, or other means, as not acceptable or not conforming to Contract requirements, the "Value of Work Completed" portion of the first Form CO-12 submitted after such identification shall be modified to reduce the "completed" value of that Work by deleting the value of that which has been identified as not acceptable or nonconforming.

21. ACCESS TO WORK

The Architect/Engineer, the Owner, the Project Manager, the Owner's inspectors and other testing personnel, inspectors from the Department of Labor and Industry, and others authorized by the Owner, shall have access to the Work at all times. The Contractor shall provide proper facilities for access and inspection.

22. SURVEYS AND LAYOUT

(a) The Owner shall furnish the Contractor all necessary documents showing property lines and the location of existing buildings and improvements. The Contractor shall provide competent surveying and engineering services to execute the Work in accordance with the Contract and shall be responsible for the accuracy of these surveying and engineering services.

(b) Such general reference points and benchmarks on the Site as will enable the Contractor to proceed with the Work will be established in the plans and specifications. If the Contractor finds that any previously established reference points have been lost or destroyed, he shall promptly notify the Architect/Engineer.

(c) The Contractor shall protect and preserve the established benchmarks and monuments and shall make no changes in locations without written notice to the Architect/Engineer and the written approval from the Owner. Any of these which may be lost or destroyed or which require shifting because of necessary changes in grades or locations shall, subject to prior written approval of the Owner, be replaced and accurately located by the Contractor.

23. PLANS AND SPECIFICATIONS

(a) The general character and scope of the Work are illustrated by the plans and the specifications. If the Contractor deems additional detail or information to be needed, he may request the same in writing from the Architect/Engineer. His request shall precisely state the detail or information needed and shall explain why it is needed. The Contractor shall also indicate a date when the requested information is required. The Architect/Engineer shall provide by Field Order such further detail and information as is necessary by the date required so long as the date indicated is reasonable. Any additional drawings and instructions supplied to the Contractor shall be consistent with the Contract Documents, shall be true developments thereof, and shall be so prepared that they can be reasonably interpreted as a part thereof. The Contractor shall carry out the Work in accordance with the additional detail drawings and instructions.

(b) If the Contractor finds a conflict, error, or other discrepancy in the plans or specifications, he shall notify the Architect/Engineer in writing as soon as possible, but before proceeding with the affected Work. The Architect/Engineer shall issue a clarification by Field Order to the Contractor stating the correct requirements. If the Contractor deems the Field Order requires additional Work, he shall notify the A/E of such prior to proceeding with that Work and he shall submit a request for Change Order along with a detailed substantiating cost proposal thru the A/E to the Owner within ten (10) calendar days.

(c) In case of differences between small and large scale drawings, the large scale drawings shall govern. Where on any of the drawings a portion of the Work is drawn out and the remainder is indicated in outline, the parts drawn out shall apply also to all other like portions of the Work.

(d) Where the word "similar" appears on the drawings, it shall be interpreted in its general sense and not as meaning identical, and all details shall be worked out in relation to their location and their connection with other parts of the Work.

(e) The specifications are divided into several parts, or sections, for convenience only, since the entire specifications must be considered as a whole. The divisions of the specifications are not intended to control the Contractor in dividing the Work among Subcontractors or to limit the Work performed by any trade. The Contractor shall be solely responsible for the coordination of the trades, Subcontractors and vendors engaged in the Work.

(f) Measurements or dimensions shown on the drawings for Site features, utilities and structures shall be verified at the Site by the Contractor. The Contractor shall not scale measurements or dimensions from the drawings. If there are discrepancies, the Architect/Engineer shall be consulted. If new Work is to connect to, match with or be provided in existing Work, the Contractor shall verify the actual existing conditions and necessary dimensions prior to ordering or fabrication.

(g) As-Built Drawings: The Contractor shall maintain at the Site for the Owner one copy of all drawings, specifications, addenda, approved shop or setting drawings, Change Orders and other modifications (collectively referred to herein as "As-Built Drawings") in good order and marked to record all changes as they occur during construction. These shall be available to the Architect/Engineer, the Owner, the Project Inspector, the Owner's other inspectors and to the Owner's testing personnel. The drawings shall be neatly and clearly marked in color during construction to record all variations made during construction. The representation of such variations shall include such supplementary notes, symbols, legends, and details as may be necessary to clearly show the as-built construction.

(h) Record Drawings: Upon completion of the Work and prior to the final inspection, the Contractor shall deliver to the Architect/Engineer, for preparation of the Record Drawings, one complete set of "As-Built Drawings" referred to in the preceding subsection.

24. SUBMITTALS

(a) The Contractor shall submit a listing of all Submittals required by the Architect/Engineer or which the Contractor identifies as necessary, fixing the dates for the submission of shop or setting drawings, samples and product data. The listing shall be in a format acceptable to the Architect/Engineer. The Contractor shall identify all Submittals with the Owner's Project Code Number as required by Section 2(f).

(b) Submittals shall be forwarded to the Architect/Engineer for approval if required by the specifications or if requested by the Architect/Engineer or the Owner. No part of the Work dealt with by a Submittal shall be fabricated by the Contractor, save at his own risk, until such approval has been given.

(c) The Contractor shall furnish to the Architect/Engineer for approval the name of the manufacturer, the model number, and other identifying data and information respecting the performance, capacity, nature and rating of the machinery and mechanical and other equipment which the Contractor contemplates incorporating in the Work. When Submittals are required by this Contract for materials, the Contractor shall furnish full information concerning the material or articles which he contemplates incorporating in the Work. When required, samples shall be submitted for approval at the Contractor's expense, with all shipping charges prepaid. Machinery, equipment, material and articles installed or used without required approval shall be at the risk of subsequent rejection.

(d) Unless otherwise indicated or required elsewhere in the specifications, shop drawings shall be submitted in the form of one reproducible tracing and three blue line or black line prints. Catalog cuts, product data and other non-reproducible literature, except certificates, shall be submitted in six (6) copies minimum, of which three (3) will be retained by the Architect/Engineer and the remainder will be returned to the Contractor.

(e) Submittals shall be accompanied by a letter of transmittal which shall list the Project Code Number, the Submittals included, the specification section number applicable to each, and the date shown on each Submittal. Submittals shall be complete in every respect and bound in sets. Each Submittal shall be clearly marked to show each item, component and/or optional feature proposed to be incorporated into the Project. Cross reference to the plans or specifications as needed to identify the use for which the item or component is intended.

(f) The Contractor shall check the Submittals for compliance with the requirements of the Contract Documents. The Contractor shall clearly note in writing any and all items which deviate from the requirements of the Contract Documents. Reasons for deviation shall be included with the Submittal. The Contractor shall be solely responsible for checking all dimensions and coordinating all materials and trades to ensure that the components or products proposed, individually or in combination, will fit in the space available and that they will be compatible with other components or products provided.

(g) After checking each submittal, the Contractor shall stamp each sheet of the Submittal with the Contractor's review stamp. Data submitted in a bound volume or on one sheet printed on two sides, may be stamped on the front of the first sheet only. The Contractor's review stamp shall be worded as follows:

> The equipment and material shown and marked in this submittal is that proposed to be incorporated into this Project, is in compliance with the Contract drawings and specifications unless otherwise shown in bold face type or lettering and listed on a page or pages headed "DEPARTURES FROM DRAWINGS AND SPECIFICATIONS", and can be installed in the allocated spaces.
>
> Reviewed by _____ Date _____

The person signing the review stamp shall be the person designated in writing by the Contractor as having that authority. (A copy of such designation shall be forwarded to the A/E prior to or with the first Submittal.) The signature on the stamped review statement shall be handwritten in ink. Stamped signatures are not acceptable.

(h) The Contractor shall forward all Submittals sufficiently in advance of construction requirements to allow reasonable time for checking, correcting, resubmitting and rechecking.

(i) If a Submittal indicates a departure from the Contract requirements, the Architect/Engineer may reject the Submittal or, if he deems it to have merit, may recommend it to the Owner, who shall approve or reject it as the Owner, in its sole discretion, sees fit. The departure from the Contract requirements shall be further authorized by a Change Order, if a reduction or increase in the Contract Price is appropriate.

(j) The Architect/Engineer is responsible to the Owner, but not to the Contractor, to verify that the Submittals conform to the design concept and functional requirements of the plans and specifications, that the detailed design portrayed in shop drawings and proposed equipment and materials shown in Submittals are of the quality specified and will function properly, and that the Submittals comply with the Contract Documents.

(k) The Work shall be in accordance with approved Submittals. Approval of the Contractor's Submittals by the A/E does not relieve the Contractor from responsibility of complying with the Contract and all drawings and specifications, except as changed by Change Order.

(l) The plans and/or specifications may indicate that the Architect/Engineer designed or detailed a portion of the plans around a particular product (most commonly a piece of equipment). Should a different product be proposed by the Contractor and accepted, all modifications, rerouting, relocations and variations required for proper installation and coordination to comply with the design concept and requirements of the Contract Documents shall be the responsibility of the Contractor and shall be made at no extra cost to the Owner. If the plans were noted as designed or detailed around a particular product and/or if a product is named when a "brand name or equal" specification has been used, this is not intended to favor or preclude the use of other products pursuant to Section 26 of these General Conditions. Rather such design merely acknowledges the reality that in many instances the Architect/Engineer must have a basis to design and detail around for dimensions and characteristics of a product or system.

(m) Additional Submittal requirements are shown in the specifications.

25. FEES, SERVICES AND FACILITIES

(a) The Contractor shall obtain all permits, except the Building Permit, and pay for all fees and charges necessary for temporary access and public right-of-way blockage or use, for temporary

connections to utilities and for the use of property (other than the Site) for storage of materials and other purposes unless otherwise specifically stated in the Contract Documents.

(b) Certain projects such as renovations and interior modifications of existing buildings will usually have water and electric service to the building. In those instances, water and electric power, if required for the Work under the Contract, will be furnished by the Owner subject to reasonable use by the Contractor, only to the extent and capacity of present services. The Contractor shall be responsible for providing required connections, temporary wiring, piping, etc. to these services in a safe manner and in accordance with applicable codes. All temporary wire, pipe, etc. shall be removed before the Substantial Completion inspection. Acceptance by the Contractor of the use of Owner's water and electricity constitutes a release to the Owner of all claims and of all liability to the Contractor for whatever damages which may result from power and water outages or voltage variations.

(c) The Owner shall pay any connection charges for permanent utility connections directly to the utility Supplier. The Contractor shall coordinate such connections with the utility Supplier.

(d) It is understood that, except as otherwise specifically stated in the Contract Documents, the Contractor, either directly or through his Subcontractors, shall provide and pay for all material, labor, tools, equipment, water, light, power, telephone and other services or facilities of every nature whatsoever necessary to execute completely and deliver the Work within the Contract Time for Completion or before the Contract Completion Date.

(e) The Contractor shall provide temporary facilities including Contractor's office space, Owner's Project Inspector office space (if required by the specifications), toilet facilities, and storage space, as required for the operations and the protection of the material and work. Number, sizes and locations shall be subject to approval of the Owner. Sanitary facilities shall be an approved type of chemical toilet and shall be regularly serviced.

26. EQUALS

(a) **Brand names:** Unless otherwise stated in the specifications, the name of a certain brand, make or manufacturer denotes the characteristics, quality, workmanship, economy of operation and suitability for the intended purpose of the article desired, but does not restrict the Contractor to the specific brand, make, or manufacturer; it is set forth to convey to the Contractor the general style, type, character and quality of the article specified.

(b) **Equal materials, equipment or assemblies:** Whenever in these Contract Documents, a particular brand, make of material, device or equipment is shown or specified, such brand, make of material, device or equipment shall be regarded merely as a standard. Any other brand, make or manufacturer of a product, assembly or equipment which in the opinion of the Architect/Engineer is the equal of that specified, considering quality, capabilities, workmanship, configuration, economy of operation, useful life, compatibility with design of the Work, and suitability for the intended purpose, will be accepted unless rejected by the Owner as not being equal.

(c) **Substitute materials, equipment or assemblies:** The Contractor may propose to substitute a material, product, equipment, or assembly which deviates from the requirements of the Contract Documents but which the Contractor deems will perform the same function and have equal capabilities, service life, economy of operations, and suitability for the intended purpose. The proposal must include any cost differentials proposed. The Owner will have the A/E provide an initial evaluation of such proposed substitutes and provide a recommendation on acceptability and indicate the A/E's redesign fee to incorporate the substitution in the design. If the proposed substitute is acceptable to the Owner, a Change Order will be proposed to the Contractor to accept the substitute and to deduct the cost of the A/E redesign fee and the proposed cost savings from the Contract Price. The Owner shall have the right to limit or reject substitutions at its sole discretion.

(d) The Contractor shall be responsible for making all changes in the Work necessary to adapt and accommodate any equal or substitute product which it uses. The necessary changes shall be made at the Contractor's expense.

27. AVAILABILITY OF MATERIALS

If a brand name, product, or model number included in the Contract Documents is not available on the present market, alternate equal products or model numbers may be proposed by the Contractor through the Architect/Engineer for approval by the Owner.

28. CONTRACTOR'S TITLE TO MATERIALS

No materials or supplies for the Work shall be purchased by the Contractor, or by any Subcontractor or Supplier, subject to any security interest, installment or sales contract or any other agreement or lien by which an interest is retained by the seller or is given to a secured party. The Contractor warrants that he has clear and good title to all materials and supplies which he uses in the Work or for which he accepts payment in whole or in part.

29. STANDARDS FOR MATERIALS INSTALLATION & WORKMANSHIP

(a) Unless otherwise specifically provided in the Contract, all equipment, material, and accessories incorporated in the Work are to be new and in first class condition.

(b) Unless specifically approved by the Owner or required by the Contract, the Contractor shall not incorporate into the Work any materials containing asbestos or any material known by the industry to be hazardous to the health of building construction workers, maintenance workers, or occupants. If the Contractor becomes aware that a material required by the Contract contains asbestos or other hazardous materials, he shall notify the Owner and the Architect/Engineer immediately and shall take no further steps to acquire or install any such material without first obtaining Owner approval.

(c) All workmanship shall be of the highest quality found in the building industry in every respect. All items of Work shall be done by craftsmen or tradesmen skilled in the particular task or activity to which they are assigned. In the acceptance or rejection of Work, no allowance will be made for lack of skill on the part of workmen. Poor or inferior workmanship (as determined by the Architect/Engineer, the Owner or other inspecting authorities) shall be removed and replaced at Contractor's expense such that the Work conforms to the highest quality standards of the trades concerned, or otherwise corrected to the satisfaction of the Architect/Engineer, the Owner, or other inspecting authority, as applicable.

(d) Under the various sections of the plans or specifications, where specified items are supplied with the manufacturer's printed instructions, recommendations, or directions for installation, or where such instructions, recommendations, or directions are available, installation of the specified items shall be in strict accordance with the manufacturer's printed instructions unless those instructions contradict the plans or specifications, in which case the Architect/Engineer will be notified for an interpretation and decision.

(e) Under the various sections of the plans or specifications, where reference is made to specific codes or standards governing the installation of specified items, installation shall in all cases be in strict accordance with the referenced codes and standards. Where no reference is made to specific codes or standards, installation shall conform to the generally recognized applicable standards for first-class installation of the specific item to be installed. Contractors are expected to be proficient and skilled in their respective trades and knowledgeable of the Codes and Standards of the National Fire Protection Association (NFiPA), National Electric Code (NEC), Occupational Safety and Health Act (OSHA) and other codes and standards applicable to installations and associated work by his trade.

(f) Where the manufacturer's printed instructions are not available for installation of specific items, where specific codes or standards are not referenced to govern the installation or specific items, or where there is uncertainty on the part of the Contractor concerning the installation procedures to be followed

or the quality of workmanship to be maintained in the installation of specific items, the Contractor shall consult the Architect/Engineer for approval of the installation procedures or the specific standards governing the quality of workmanship the Contractor proposes to follow or maintain during the installation of the items in question.

(g) During and/or at the completion of installation of any items, the tests designated in the plans or specifications necessary to assure proper and satisfactory functioning for its intended purpose shall be performed by the Contractor or by its Subcontractor responsible for the completed installation. All costs for such testing are to be included in the Contract Price. If required by the Contract Documents, the Contractor shall furnish prior to final inspection the manufacturers' certificates evidencing that products meet or exceed applicable performance, warranty and other requirements, and certificates that products have been properly installed and tested.

30. WARRANTY OF MATERIALS AND WORKMANSHIP

(a) The Contractor warrants that, unless otherwise specified, all materials and equipment incorporated in the Work under the Contract shall be new, in first class condition, and in accordance with the Contract Documents. The Contractor further warrants that all workmanship shall be of the highest quality and in accordance with the Contract Documents and shall be performed by persons qualified at their respective trades.

(b) Work not conforming to these warranties shall be considered defective.

(c) This warranty of materials and workmanship is separate and independent from and in addition to any of the Contractor's other guarantees or obligations in the Contract or under Virginia law.

31. USE OF SITE AND REMOVAL OF DEBRIS

(a) The Contractor shall:

(1) Perform the Work in such a manner as not to interrupt or interfere with the operation of any existing activity on, or in proximity to, the Site or with the Work of any other separate contractor;

(2) Store his apparatus, materials, supplies and equipment in such orderly fashion at the Site of the Work as will not unduly interfere with the progress of his Work or the work of any other separate contractor; and

(3) Place upon the Work or any part thereof only such loads as are consistent with the safety of that portion of the Work.

(b) The Contractor expressly undertakes, either directly or through his Subcontractor(s), to effect all cutting, filling or patching of the Work required to make the same conform to the plans and

specifications, and, except with the consent of the Architect/Engineer, not to cut or otherwise alter the Work of any other separate contractor. The Contractor shall not damage or endanger any portion of the Work or Site, including existing improvements, unless called for by the Contract.

(c) The Contractor expressly undertakes, either directly or through his Subcontractor(s), to clean up frequently all refuse, rubbish, scrap materials and debris caused by his operations, to the end that at all times the Site shall present a neat, orderly and workmanlike appearance. No such refuse, rubbish, scrap material and debris shall be left within the completed Work nor buried on the building Site, but shall be removed from the Site and properly disposed of in a licensed landfill or otherwise as required by law.

(d) The Contractor expressly undertakes, either directly or through his Subcontractor(s), before final payment or such prior time as the Owner may require, to remove all surplus material, false Work, temporary structures, including foundations thereof, plants of any description and debris of every nature resulting from his operations and to put the Site in a neat, orderly condition; to thoroughly clean and leave reasonably dust free all finished surfaces including all equipment, piping, etc., on the interior of all buildings included in the Contract; and to clean thoroughly all glass installed under the Contract, including the removal of all paint and mortar splatters and other defacements. If the Contractor fails to clean up at the time required herein, the Owner may do so and charge the costs incurred thereby to the Contractor in accordance with Section 10 (b) of these General Conditions.

(e) The Contractor shall have, On-Site, an employee certified by the Department of Conservation and Recreation as a Responsible Land Disturber who shall be responsible for the installation, inspection and maintenance of erosion control and stormwater management measures and devices. The Contractor shall prevent Site soil erosion, the runoff of silt and/or debris carrying water from the Site, and the blowing of debris off the Site in accordance with the applicable requirements and standards of the Contract and the Virginia Department of Conservation and Recreation's Erosion and Sediment Control Regulations and the Virginia Stormwater Management Regulations.

32. TEMPORARY ROADS

Temporary roads, if required, shall be established and maintained until permanent roads are accepted, then removed and the area restored to the conditions required by the Contract Documents. Crushed rock, paving and other road materials from temporary roads shall not be left on the Site unless permission is received from the Owner to bury the same at a location and depth approved by the Owner.

33. SIGNS

The Contractor may, at his option and without cost to the Owner, erect signs acceptable to the Owner on the Site for the purpose of identifying and giving directions to the job. No signs shall be erected without prior approval of the Owner as to design and location.

34. PROTECTION OF PERSONS AND PROPERTY

(a) The Contractor expressly undertakes, both directly and through his Subcontractors, to take every reasonable precaution at all times for the protection of all persons and property which may come on the Site or be affected by the Contractor's Work.

(b) The Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Any violation of these requirements or duties or any potential safety hazard that is brought to the attention of the Contractor by the Architect/Engineer, the Owner, or any other persons shall be immediately abated.

(c) The provisions of all rules and regulations governing health and safety as adopted by the Safety Codes Commission of the Commonwealth of Virginia, issued by the Department of Labor and Industry under Title 40.1 of the Code of Virginia, shall apply to all Work under this Contract.

(d) The Contractor shall continuously maintain adequate protection of all his Work from damage and shall protect the Owner's property from injury or loss arising in connection with this Contract. He shall make good any such damage, injury or loss, except as may be directly and solely due to errors in the Contract Documents or caused by agents or employees of the Owner. The Contractor shall adequately protect adjacent property to prevent any damage to it or loss of use and enjoyment by its owners. The Contractor shall provide and maintain all passageways, guard fences, lights and other facilities for protection as required by public authority, local conditions, or the Contract.

(e) In an emergency affecting the health, safety or life of persons or of the Work, or of the adjoining property, the Contractor, without special instruction or authorization from the Architect/Engineer or the Owner, shall act, at his discretion, to prevent such threatened loss or injury. Also, should he, to prevent threatened loss or injury, be instructed or authorized to act by the Architect/Engineer or the Owner, he shall so act immediately, without appeal. Any additional compensation or extension of time claimed by the Contractor on account of any emergency work shall be determined as provided by Section 38 of these General Conditions.

(f) When necessary for the proper protection of the Work, temporary heating of a type approved by the Architect/Engineer must be provided by the Contractor, at the Contractor's expense, unless otherwise specified.

35. CLIMATIC CONDITIONS

The Contractor shall suspend activity on and protect any portion of the Work that may be subject to damage by climatic conditions.

36. PAYMENTS TO CONTRACTOR

(a) Unless otherwise provided in the Contract, the Owner will make partial payments to the Contractor on the basis of a duly certified and approved Schedule of Values and Certificate for Payment, Form CO-12, showing the estimate of the Work performed during the preceding calendar month or work period, as recommended by the Architect/Engineer. When evaluating the Contractor's Form CO-12, the Architect/Engineer will consider the value of the Work in place, the value of approved and properly stored materials, the status of the Work on the critical path with regard to the Time for Completion, and the estimated value of the Work necessary to achieve Final Completion. The Architect/Engineer will schedule a monthly pay meeting to occur no earlier than the 25th day of the month represented by the payment request or not later than the 5th day of the following month. The Contractor will submit his monthly estimate of Work completed on Form CO-12 so that it is received by the Architect/Engineer and the Owner's Project Manager at least one work day prior to the date scheduled by the Architect/Engineer for the monthly pay meeting. The Owner will review the estimate with the Architect/Engineer and the Contractor at the monthly pay meeting, which shall be considered the receipt date, and may approve any or all of the estimate of Work for payment. In preparing estimates, the material delivered to the Site and preparatory Work done shall be taken into consideration, if properly documented as required by Section 20 of these General Conditions, or as may be required by the Architect/Engineer so that quantities may be verified. In addition to material delivered to the Site, material such as large pieces of equipment and items purchased specifically for the Project, but stored off the Site within the Commonwealth of Virginia, may be considered for payment, provided all of the following are

accomplished prior to the submission of the monthly payment request in which payment for such materials is requested:

(1) The Contractor must notify the Owner in writing, at least ten (10) days prior to the submission of the payment request, through the Architect/Engineer, that specific items will be stored off Site in a designated, secured place within the Commonwealth of Virginia. The Schedule of Values must be detailed to indicate separately both the value of the material and the labor/installation for trades requesting payment for stored materials. By giving such notification and by requesting payment for material stored off Site, the Contractor warrants that the storage location is safe and suitable for the type of material stored and that the materials are identified as being the property of the Contractor, and agrees that loss of materials stored off the Site shall not relieve the Contractor of the obligation to timely furnish these types and quantities of materials for the Project and meet the Time for Completion or Contract Completion Date, subject to Section 43 (b) of these General Conditions. If the storage location is more than 20 miles from the Site, the Contractor may be required to reimburse the Owner for the cost incurred for travel to the storage location to verify the Contractor's request for payment for materials stored off Site.

(2) Such notification, as well as the payment request, shall:

(a) itemize the quantity of such materials and document with invoices showing the cost of said materials;

(b) indicate the identification markings used on the materials, which shall clearly reference the materials to the particular project;

(c) identify the specific location of the materials, which must be within reasonable proximity to the Site and within the Commonwealth of Virginia;

(d) include a letter from the Contractor's Surety which confirms that the Surety on the Performance Bond and the Labor and Material Payment Bond has been notified of the request for payment of materials stored off the Site and agrees that the materials are covered by the bond; and

(e) include a certificate of all-risk builder's risk insurance in an amount not less than the fair market value of the materials, which shall name the Owner and the Contractor as co-insureds.

(3) The Architect/Engineer shall indicate, in writing, to the Owner that Submittals for such materials have been reviewed and meet the requirements of the Contract Documents, that the stored materials meet the requirement of the plans and specifications, and that such materials conform to the approved Submittals. Should the A/E deem it necessary to visit the storage site to make such review, the Contractor shall bear the costs incurred therewith.

(4) The Owner, through the Architect/Engineer, shall notify the Contractor in writing of its agreement to prepayment for materials.

(5) The Contractor shall notify the Owner in writing, through the Architect/Engineer, when the materials are to be transferred to the Site and when the materials are received at the Site.

(b) Payment will not be made for materials or equipment stored on or off the Site which are not scheduled for incorporation into the Work within the six months next following submission of the request for payment, unless the Contractor has the prior consent of the Owner, which consent may be granted or withheld by the Owner in its discretion if, in the opinion of the Owner, it is not necessary to procure the materials more than six months in advance of use to assure their availability when needed.

(c) No payment shall be made to the Contractor until the Contractor furnishes to the Owner its Social Security Number (SSN) if an individual, or its Federal Employer Identification Number (FEIN) if a proprietorship, partnership, corporation or other legal entity. No payment shall be made to the Contractor until Certificates of Insurance or other satisfactory evidence of compliance by the Contractor with all the requirements of Section 11 (and Section 12 if applicable) of these General Conditions have been delivered to the Owner. Further, no payments on the basis of Work performed by a Subcontractor shall be paid by the Owner until copies of any certificates of insurance required of the Subcontractor under Section 11 have been delivered to the Owner.

(d) In making such partial payments, five percent (5%) of each payment to the Contractor shall be retained until Final Completion and acceptance of all Work covered by the Contract, unless otherwise provided by any law, regulation or program of the federal government. Such retainage shall be held to assure faithful performance of the Contract and may also be used as a fund to deduct amounts due to or claimed by the Owner, including, but not limited to, payment to the Owner of all moneys due for deductive change orders, credits, uncorrected Defective Work, interest, damages, and the like. (§2.2-4333 of the Code of Virginia) The Owner may, at its sole discretion, agree on an item by item basis to release the retainage on items which are fully 100% complete and which have accepted by the Owner as being tested and complete and on which no further action or work will be required. Retainage which is released by the Owner shall be distributed by the Contractor in conformance with Section 37 of these General Conditions.

(e) All material and Work for which partial payments are made shall thereupon become the sole property of the Owner, but this provision shall not relieve the Contractor from the sole responsibility for all materials and Work, including those for which payment has been made, or for the restoration of any damaged materials or Work. Nor shall this provision serve as a waiver of the right of the Owner to require the fulfillment of all of the terms and conditions of the Contract.

(f) The final payment, which shall include the retainage, less any amounts due to or claimed by the Owner, shall not become due until the Architect/Engineer and the Owner agree that Final Completion has been achieved and until the Contractor shall deliver to the Owner through the Architect/Engineer a Certificate of Completion by the Contractor (Form CO-13.2) and an Affidavit of Payment of Claims (Form CO-13), stating that all Subcontractors and Suppliers of either labor or materials have been paid all sums claimed by them for Work performed or materials furnished in connection with this Project less retainage. Amounts due the Owner which may be withheld from the final payment may include, but are not limited to, amounts due pursuant to Section 3(i), Section 16(a)-(d), Section 31(d), costs incurred to repair or replace Defective Work, costs incurred as a result of the Contractor's negligent acts or omissions or omissions of those for whom the Contractor is responsible, delay damages under Section 43(h), and any liquidated or actual damages. If all Subcontractors and Suppliers of labor and materials have not been paid the full amount claimed by them, the Contractor shall list each to which an agreed amount of money is due or which has a claim in dispute. With respect to all such Subcontractors and Suppliers, the Contractor shall provide to the Owner, along with the Affidavit of Payment of Claims (Form CO-13), an affidavit from each such Subcontractor and Supplier stating the amount of their subcontract or supply contract, the percentage of completion, the amounts paid to them by the Contractor and the dates of payment, the amount of money still due if any, any interest due the Subcontractor or Supplier pursuant to Section 37(b) below, and whether satisfactory arrangements have been made for the payment of said amounts. If no agreement can be reached between the Contractor and one or more Subcontractors or Suppliers as to the amounts owed to the Subcontractors or Suppliers, the Owner may, in its discretion, pay such portion of the moneys due to the Contractor which is claimed by the Subcontractor or Supplier into a Virginia Court or Federal Court sitting in Virginia, in the manner provided by law. Said payment into court shall be deemed a payment to the Contractor. Nothing in this Section shall be construed as creating any obligation or contractual relationship between the Owner and any Subcontractor or Supplier, and the Owner shall not be liable to any Subcontractor or Supplier on account of any failure or delay of the Owner in complying with the terms hereof.

(g) Upon successful completion of the final inspection and all Work required by the Contract, including but not limited to the delivery of As-Built drawings, equipment manuals, written warranties, acceptance of the Work by the Owner and the delivery of the affidavits required in Section 36(f) of these General Conditions, the Architect/Engineer shall deliver the written Certificate of Completion by the Architect/Engineer (Form CO-13.1) to the Owner, with a copy to the Contractor, stating the entire amount of Work performed and compensation earned by the Contractor, including extra work and compensation therefor. The Owner may accept the Work for occupancy or use while asserting claims against the Contractor; disputing the amount of compensation due to the Contractor; disputing the quality of the Work, its completion, or its compliance with the Contract Documents; or any other reason.

(h) Unless there is a dispute about the compensation due to the Contractor, Defective Work, quality of the Work, compliance with the Contract Documents, completion itself, claims by the Owner, other matters in contention between the parties, or unless monies are withheld pursuant to the Comptroller's Debt Setoff Program, within thirty (30) days after receipt and acceptance of the Schedule of Values and Certificate for Payment (Form CO-12) in proper form by the Architect/Engineer at the monthly pay meeting, which shall be considered the receipt date, the Owner shall pay to the Contractor the amount approved by the Architect/Engineer, less all prior payments and advances whatsoever to or for the account of the Contractor. In the case of final payment, the completed Affidavit of Payment of Claims (Form CO-13), the Certificate of Completion by the Contractor (Form CO-13.2) and the Certificate of Completion by the Architect/Engineer (Form CO-13.1) shall accompany the final Schedule of Values and Certificate for Payment (Form CO-12) which is forwarded to the Owner for payment. The date on which payment is due shall be referred to as the Payment Date. In the event of disputes, payment shall be mailed on or before the Payment Date for amounts and Work not in dispute, subject to any set offs claimed by the Owner; provided, however in instances where further appropriations are required by the General Assembly or where the issuance of further bonds is required, in which case, payment shall be made within thirty (30) days after the effective date of such appropriation or within thirty (30) days after the receipt of bond proceeds by the Owner. All prior estimates and payments including those relating to extra Work may be corrected and adjusted in any payment and shall be corrected and adjusted in the final payment. In the event that any request for payment (CO-12) by the Contractor contains a defect or impropriety, the Owner shall notify the Contractor of any defect or impropriety which would prevent payment by the Payment Date, within five (5) days after receipt of the Schedule of Values and Certificate for Payment (Form CO-12) by the Owner from the Architect/Engineer.

(i) Interest shall accrue on all amounts owed by the Owner to the Contractor which remain unpaid seven (7) days following the Payment Date. Said interest shall accrue at the discounted ninety-day U.S. Treasury bill rate as established by the Weekly Auction and as reported in the publication entitled The Wall Street Journal on the weekday following each such Weekly Auction. During the period of time when the amounts due to the Contractor remain unpaid following the seventh (7) day after the Payment Date, the interest accruing shall fluctuate on a weekly basis and shall be that established by the immediately prior Weekly Auction. It shall be the responsibility of the Contractor to gather and substantiate the applicable weekly interest rates to the satisfaction of the Owner and to calculate to the satisfaction of the Owner the interest due. In no event shall the rate of interest charge exceed the rate of interest charged pursuant to §58.1-1812 of the Code of Virginia. No interest shall accrue on retainage or when payment is delayed because of disagreement between the Owner and the Contractor regarding the quantity, quality or timeliness of the Work, including, but not limited to, compliance with Contract Documents or the accuracy of any Request for Payment received. This exception to the accrual of interest stated in the preceding sentence shall apply only to that portion of a delayed payment which is actually the subject of such a disagreement and shall apply only for the duration of such disagreement. Nothing contained herein shall be interpreted, however, to prevent the withholding of retainage to assure faithful performance of the Contract. These same provisions relating to payment of interest to the Contractor shall apply also to the computation and accrual of interest on any amounts due from the Contractor to the Owner for deductive change orders and to amounts due on any claims by the Owner. The date of mailing of any payment by the U.S. Mail is deemed to be the date of payment to the addressee.

(j) The acceptance by the Contractor of the final payment shall be and operate as a release to the Owner of all claims by the Contractor, its Subcontractors and Suppliers, and of all liability to the Contractor whatever, including liability for all things done or furnished in connection with this Work, except for things done or furnished which are the subject of unresolved claims for which the Contractor has filed a

timely written notice of intent, provided a claim is submitted no later than sixty (60) days after final payment. Acceptance of any interest payment by the Contractor shall be a release of the Owner from claims by the Contractor for late payment.

(k) No certificate for payment issued by the Architect/Engineer, and no payment, final or otherwise, no certificate of completion, nor partial or entire use or occupancy of the Work by the Owner, shall be an acceptance of any Work or materials not in accordance with the Contract, nor shall the same relieve the Contractor of responsibility for faulty materials or Defective Work or operate to release the Contractor or his Surety from any obligation under the Contract, the Standard Performance Bond and the Standard Labor and Material Payment Bond.

37. PAYMENTS BY CONTRACTOR (§2.2-4354, Code of Virginia)

Under §2.2-4354, Code of Virginia, the Contractor is obligated to:

(a) Within seven (7) days after receipt of amounts paid to the Contractor by the Owner for Work performed by the Subcontractor or Supplier under this Contract,

(1) Pay the Subcontractor or Supplier for the proportionate share of the total payment received from the Owner attributable to the Work performed by the Subcontractor or the materials furnished by the Supplier under this Contract; or

(2) Notify the Subcontractor or Supplier, in writing, of his intention to withhold all or a part of the Subcontractor or Supplier's payment with the reason for nonpayment;

(b) Pay interest to the Subcontractor or Supplier on all amounts owed by the Contractor that remain unpaid after seven (7) days following receipt by the Contractor of payment from the Owner for Work performed by the Subcontractor or materials furnished by the Supplier under this contract, except for amounts withheld as allowed under subsection (a) (2) of this Section.

(c) Include in each of his subcontracts a provision requiring each Subcontractor to include in each of its subcontracts a provision requiring each subcontractor to include or otherwise be subject to the same payment and interest requirements with respect to each lower tier subcontractor. Each Subcontractor shall include with its invoice to, or request for payment from, the Contractor, a certification that that Subcontractor has paid each of its suppliers and lower tier subcontractors their proportionate share of previous payments received from the Contractor attributable to the Work performed or the materials furnished by it under this Contract.

The Contractor's obligation to pay interest to the Subcontractor or Supplier pursuant to subsection (b) of this Section is not an obligation of the Owner. A modification to this Contract shall not be made for the purpose of providing reimbursement for such interest charge. A Contractor's cost reimbursement claim shall not include any amount for reimbursement of such interest charge.

38. CHANGES IN THE WORK

(a) The Owner may at any time, by written order utilizing the Commonwealth of Virginia Change Order Form CO-11 and without notice to the sureties, make changes in the Work which are within the general scope of the Contract, except that no change will be made which will increase the total Contract Price to an amount more than twenty percent (20%) in excess of the original Contract Price without notice to sureties. At the time of the Preconstruction Meeting described in Section 50(b), the Contractor and the Owner shall advise each other in writing of their designees authorized to accept and/or approve changes to the Contract Price and of any limits to each designee's authority. Should any designee or limits of authority change during the time this Contract is in effect, the Contractor or Owner shall give written notice to the other within seven (7) calendar days, utilizing the procedures set forth in these General Conditions. The Contractor agrees and understands that the authority of the Owner's designee is limited by Virginia Code §2.2-4309 and any other applicable statute.

In making any change, the charge or credit for the change shall be determined by one of the following methods as selected by the Owner:

(1) By a mutually agreed fixed amount change to the Contract Price and/or time allowed for completion of the Work. The Change Order shall be substantiated by documentation itemizing the estimated quantities and costs of all labor, materials and equipment required as well as any mark-up used. The price change shall include the Contractor's overhead and profit. See Subsections (d) and (e) below.

(2) By using unit prices and calculating the number of net units of Work in each part of the Work which is changed, either as the Work progresses or before Work on the change commences, and by then multiplying the calculated number of units by the applicable unit price set forth in the Contract or multiplying by a mutually agreed unit price if none was provided in the Contract. No additional percentage markup for overhead or profit shall be added to the unit prices.

(3) By ordering the Contractor, by Change Order citing this subsection, to proceed with the change to the Work; to keep in a form acceptable to the Owner, an accurate, itemized account of the cost of the change in the Work, including, but not limited to, the costs of labor, materials, equipment, and supplies; and to annotate a copy of the Project schedule to accurately show the status of the Work at the time this initial change order is issued, to show the start and finish of the changed Work, and the status of the Work when the changed Work is completed. A Change Order citing this subsection shall describe the parameters of the change in the Work, describe the cost items to be itemized and verified for payment, address the impact on the schedule for Substantial Completion, and state that a subsequent Change Order will be issued to incorporate the cost of the changed Work into the Contract Price and any change in the Contract Time for Completion or Contract Completion Date. The Contractor shall sign the Change Order acknowledging he has been directed to proceed with the changed Work. The Contractor's signature on each initial Change Order authorizing Work and citing this Subsection as the method for determining the cost of the Work shall not constitute the Contractor's agreement on the cost or time impact of the changed Work.

Except as otherwise may be agreed to in writing by the Owner, such costs shall not exceed those prevailing for the trades or crafts, materials, and equipment in the locality of the Project, may include only those items listed as allowable in Subsection 38(e), and shall not include any of the costs listed as not allowable in Subsection 38(f). The Owner

shall be permitted, on a daily basis, to verify such records and may require such additional records as are necessary to determine the cost of the change to the Work.

Within fourteen (14) days of the conclusion of such ordered Work, the Contractor and the Owner shall arrive at a cost for the Change Order, based on the records kept and the Contractor's allowance for overhead and profit as set forth in Subsections (d), (e) and (f) below, and such costs shall be incorporated into a Change Order which references the Change Order ordering the Work. If agreement on the cost of the changed Work cannot be reached within the fourteen (14) days allotted, the Contractor may file a claim for the disputed amount as provided for in Section 47.

(b) The Contractor shall review any Owner requested or directed change and shall respond in writing within fourteen (14) calendar days after receipt of the proposed change (or such other reasonable time as the Owner may direct), stating the effect of the proposed change upon his Work, including any increase or decrease in the Contract time and Price. The Contractor shall furnish to the Owner an itemized breakdown of the quantities and prices used in computing the proposed change in Contract Price.

The Owner shall review the Contractor's proposal and respond to the Contractor within thirty (30) days of receipt. If a change to the Contract Price and time for performance are agreed upon, both parties shall sign the Change Order. If the price and time are not agreed upon, the Owner may direct the Contractor to proceed under Subsection 38(a)(3). Changes to the Contract time and/or Price shall be effective when signed by both parties, unless approval by the Governor or his designee is required.

(c) In figuring changes, any instructions for measurement of quantities set forth in the Contract shall be followed.

(d) The percentage for overhead and profit to be used in calculating both additive and deductive changes in the Work (other than changes covered by unit prices) shall not exceed the percentages for each category listed below. Said percentages for overhead and profit shall be applied only on the net cost of the changed Work (i.e. difference in cost between original and revised Work):

(1) If a Subcontractor does all or part of the changed Work, the Subcontractor's markup for overhead and profit on the Work it performs shall be a maximum of fifteen percent (15%). The Contractor's mark-up on the subcontractor's price shall be a maximum of ten percent (10%).

(2) If the Contractor does all or part of the changed Work, its markup for overhead and profit on the changed Work it performs shall be a maximum of fifteen percent (15%).

(3) If a Sub-subcontractor at any tier does all or part of the changed Work, the Sub-subcontractor's markup on that Work shall be a maximum of fifteen percent (15%). The markup of a sub-subcontractor's Work by the Contractor and all intervening tiers of Subcontractors shall not exceed a total of ten percent (10%).

(4) Where Work is deleted from the Contract prior to commencement of that Work without substitution of other similar Work, one hundred percent (100%) of the Contract Price attributable to that Work shall be deducted from the Contract Price. However, in the event that material Submittals have been approved and orders placed for said materials, a lesser amount, but in no case less than eighty percent (80%) of the Contract Price attributable to that Work, shall be deducted from the Contract Price. The credit to the Owner for reduced premiums on labor and material bonds and performance bonds shall in all cases be one hundred percent (100%).

(e) Allowable costs for changes in the Work may include the following:

(1) Labor costs for employees directly employed in the change in the Work, including salaries and wages plus the cost of payroll charges and fringe benefits and overtime premiums, if such premiums are explicitly authorized by the Owner.

(2) Materials incorporated into the change to the Work, including costs of transportation and storage, if applicable. If applicable, all cash discounts shall accrue to the Contractor, unless the Owner deposits funds with the Contractor to make such payments, and all trade discounts, rebates, refunds, and returns from the sale of surplus materials shall accrue to the Owner.

(3) Equipment incorporated in the changed Work or equipment used directly in accomplishing the Work. If rented expressly for accomplishing the change in the Work, the cost shall be the rental rate according to the terms of the rental agreement, which the Owner shall have the right to approve. If owned by the Contractor, the costs shall be a reasonable price based upon the life expectancy of the equipment and the purchase price of the equipment. If applicable, transportation costs may be included.

(4) Costs of increases in premiums for the Standard Labor and Material Payment Bond and the Standard Performance Bond, provided coverage for the cost of the change in the Work results in such increased costs. At the Owner's request, the Contractor shall provide proof of his notification to the Surety of the change in the Work and of the Surety's agreement to include such change in its coverage. The cost of the increase in premium shall be an allowable cost but shall not be marked up.

(5) Contractor and Subcontractor overhead costs as set forth in Subsection (d) markups above.

(6) If the change in the Work also changes the Time for Completion or Contract Completion Date by adding days to perform the Work, an itemized accounting of the following Site direct overhead expenses for the change to the time may be considered as allowable costs for compensation in addition to those shown above:

The Site superintendent's prorata salary, temporary Site office trailer expense, and temporary Site utilities including basic telephone service, electricity, heat, water, and sanitary / toilet facilities. All other direct and indirect overhead expenses are considered covered by and included in the Subsection (d) markups above.

(7) Any other costs directly attributable to the change in the Work with the exception of those set forth below.

(f) Allowable costs for changes in the Work shall not include the following:

(1) Costs due to the negligence of the Contractor, any Subcontractor, Supplier, their employees or other persons for whom the Contractor is responsible, including, but not limited to, costs for the correction of Defective Work, for improper disposal of material, for equipment wrongly supplied, for delay in performing the Work, or for delay in obtaining materials or equipment.

(2) Home office expenses including payroll costs for the Contractor's officers, executives, administrators, project managers, accountants, counsel, engineers, timekeepers, estimators, clerks, and other similar administrative personnel employed by the Contractor, whether at the Site or in the Contractor's principal or branch office for general administration of the Work. These costs are deemed overhead included in the percentage markups allowable in Subsection (d) above.

(3) Home and field office expenses not itemized in Subsection 38(e)(6) above. Such items include, but are not limited to, expenses of Contractor's home and branch offices, Contractor's capital expenses, interest on Contractor's capital used for the Work, charges for delinquent payments, small tools, incidental job costs, rent, utilities, telephone and office equipment, and other general overhead expenses.

(g) All Change Orders, except the "initial" Change Orders authorizing work citing Subsection 38(a)(3) procedures, must state that the Contract Time for Completion or Contract Completion Date is not changed or is either increased or decreased by a specific number of days. The old Time for Completion and, if changed, the new Time for Completion must be stated.

If the Contractor requests an extension to the Time for Completion or a later Contract Completion Date, he must provide written justification for the extension to the Architect/Engineer and to the Owner. The written justification must demonstrate an anticipated actual increase in the time required to complete the Work beyond that allowed by the Contract as adjusted by prior change orders or amendments to the Contract, not just an increase or decrease in the time needed to complete some portion of the total Work. When a CPM schedule is required by the Contract, no extension to the Time for Completion or Contract Completion Date shall be allowed unless, and then only to the extent that, the additional or changed Work increases the length of the critical path beyond the Time for Completion or Contract Completion Date. If approved, the increase in time required to complete the Work shall be added to the Time for Completion or Contract Completion Date.

The Owner may decrease, by Change Order, the Time for Completion or Contract Completion Date when an Owner-requested deletion from the Work results in a decrease in the actual time required to complete the Work as demonstrable on the Bar Graph Schedule or on the CPM Schedule, whichever is appropriate. The Contractor may submit a request to decrease, by Change Order, the Time for Completion or Contract Completion Date under the procedures and subject to the considerations set forth in Section 19(f). No request for such decrease shall be considered for approval unless the proposed shorter schedule is otherwise acceptable under Sections 19(b) or (c), whichever is applicable. The Change Order decreasing the Time for Completion or changing the Contract Completion Date must be signed by both the Owner and the Contractor.

With the exception of Change Orders under Subsection 38(a)(3), which shall arrive at a change to the Contract Price and any change to time using the procedures set forth therein, each Change Order shall include all time and monetary impacts of the change, whether the Change Order is considered alone or with all other changes during the course of the Project. Failure to include a change to time and Contract Price in Section 38(a)(1) or (2) Change Orders shall waive any change to the time and Contract Price unless the parties mutually agree in writing to postpone a determination of the change to time and price resulting from the Change Order. Such a determination may be postponed not more than forty-five (45) days to give the Contractor an opportunity to demonstrate a change in the time and price needed to complete the Work. During any such postponement, the Work shall proceed, unless the Owner agrees otherwise.

If at any time there is a delay in the critical path of the Work due to postponement, due to the Contractor's efforts to justify an extension of the time or an increase in the Contract Price, or due to the Contractor's refusal to proceed with any of the Work, pending agreement on a change in time or price, such delay and any Contractor costs resulting from it shall not serve as the basis for the extension of the Time for Completion or Contract Completion Date or for an increase in the Contract Price.

(h) The acceptance by the Contractor of any payment made by the Owner under a Change Order shall be and operate as a release to the Owner of all claims by the Contractor and of all liability owing to the Contractor for all things done or furnished in connection with the Work described in the Change Order. The execution of any Change Order by the Owner shall not be an acceptance of any Work or materials not in accordance with the Contract Documents, nor shall it relieve the Contractor of responsibility for faulty materials or workmanship or operate to release the Contractor or his surety from any obligation

under the Contract or the Standard Performance Bond or Standard Labor and Material Payment Bond.

(i) Payments will not be made for any Work, labor or materials performed on a unit price or a Subsection 38(a)(3) basis until the Contractor has furnished the Owner documents, certified as true and correct by an authorized officer or agent of the Contractor, evidencing the cost of such Work, labor and materials. The Owner may require any or all of the following documentation to be provided by the Contractor.

For Work performed on a Unit Price basis:

(1) certified measurements of authorized and approved excavations, over-excavations, fills and/or backfills, and similar work; and/or

(2) certified measurements of piling installed, caissons installed, and similar work; and/or

(3) daily records of waste materials removed from the Site and/or fill materials imported to the Site.

For Work performed on a Subsection 38(a)(3) basis:

(1) certified payroll records showing the name, classification, date, daily hours, total hours, rate, and extension for each laborer, foreman, supervisor or other worker;

(2) equipment type & model, dates, daily hours, total hours, rental rate or other specified rate, and extension for each unit of equipment;

(3) invoices for materials showing quantities, prices, and extensions;

(4) daily records of waste materials removed from the Site and/or fill materials imported to the Site;

(5) certified measurements of over-excavations, piling installed and similar work; and/or

(6) transportation records for materials, including prices, loads, and extensions.

Requests for payment shall be accompanied and supported by invoices for all materials used and for all transportation charges claimed. If materials come from the Contractor's own stock, then an affidavit may be furnished, in lieu of invoices, certifying quantities, prices, etc. to support the actual cost.

39. EXTRAS

If the Contractor claims that any instructions given to him by the Architect/Engineer or by the Owner, by drawings or otherwise, involve extra Work which increases the scope of the Contract, then, except in emergencies endangering life or property, he shall give the Architect/Engineer and the Owner written notice thereof before proceeding to execute the Work. Said notice shall be given promptly enough to avoid delaying the Work and in no instance later than fourteen (14) days after the receipt of such instructions. Should it not be immediately clear to the Contractor that the change involves extra Work outside the scope of the Contract, written notice shall be sufficient if given as soon as possible after such realization, but in no event later than fourteen (14) days after the start of such Work. If the Owner agrees, a Change Order shall be issued as provided in Section 38 of these General Conditions, and any additional compensation shall be determined by one of the three (3) methods provided in said Section 38, as selected by the Owner. Except as otherwise specifically provided, no claims for extra Work shall be allowed unless timely notice, as required by this Section, is given by the Contractor and unless such Work is performed pursuant to written Change Order as provided in Section 38. The Change Order shall designate which of the three methods for computing charges and credits set forth in said Section 38(a) shall be used.

40. CONTRACTOR'S RIGHT TO STOP WORK OR TERMINATE THE CONTRACT

If the Work should be stopped under an order of any court or other public authority for a period of ninety (90) days through no fault of the Contractor or anyone employed by him, or if the Owner should fail to pay to the Contractor within thirty (30) days any sum certified by the Architect/Engineer when no dispute exists as to the sum due or any provision of the Contract, then the Contractor may, upon ten (10) calendar days written notice to

the Owner and the Architect/Engineer, stop Work or terminate the Contract and recover from the Owner payment for the cost of the Work actually performed, together with overhead and profit thereon, but profit on the Work performed shall be recovered only to the extent that the Contractor can demonstrate that he would have had profit on the entire Contract if he had completed the Work. The Contractor may not receive profit or any other type of compensation for parts of the Work not performed. The Contractor may recover the reasonable cost of physically closing down the Site, but no other costs of termination. The Owner may offset any claims it may have against the Contractor against the amounts due to the Contractor. In no event shall termination of the Contract by the Contractor terminate the obligations of the Contractor's surety on its payment and performance bonds.

41. OWNER'S RIGHT TO TERMINATE THE CONTRACT FOR CAUSE

(a) If the Contractor should be adjudged as bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed on account of his insolvency, the Owner may terminate the Contract. If the Contractor should refuse or should repeatedly fail, except in cases for which extension of time is provided, to supply enough properly skilled workmen or proper materials and equipment, or if he should fail to make prompt payment to Subcontractors or Suppliers of material or labor, or if he should disregard laws, ordinances or the written instructions of the Architect/Engineer or the Owner, or otherwise be in substantial violation of any provision of the Contract, then the Owner may terminate the Contract.

(b) Prior to termination of the Contract, the Owner shall give the Contractor and his surety ten (10) calendar days written notice pursuant to Section 1 ("Notice") of these General Conditions, during which the Contractor and/or his surety may rectify the basis for the notice. If rectified to the satisfaction of the Owner within said ten (10) days, the Owner may rescind its notice of termination. If not, the termination for cause shall become effective at the end of the ten (10) day notice period. In the alternative, the Owner may, in writing, postpone the effective date of the termination for cause, at its sole discretion, if it should receive reassurances from the Contractor and/or its surety that the basis for the termination will be remedied in a time and manner which the Owner finds acceptable. If at any time after such postponement, the Owner determines that Contractor and/or its surety has not or is not likely to rectify the causes of termination in an acceptable manner or within the time allowed, then the Owner may immediately terminate the Contract for cause, without the necessity of further ten (10) day notice, by notifying the Contractor and his surety in writing of the termination. In no event shall termination for cause terminate the obligations of the Contractor's surety on its payment and performance bonds.

(c) Upon termination of the Contract, the Owner shall take possession of the Site and of all materials, tools and equipment thereon. If no security has been provided pursuant to Section 8 herein, the Owner shall finish the Work by whatever method he may deem expedient. In such case the Contractor shall not be entitled to receive any further payment. If the expense of finishing the Work, including compensation for additional managerial and administrative services, shall exceed the unpaid balance of the Contract Price, the Contractor shall pay the difference to the Owner, together with any other expenses of terminating the Contract and having it completed by others. If security has been provided pursuant to Section 8 herein, the Owner shall provide Notice to the Surety as set forth in Subsection (b) herein and proceed as set forth in the Standard Performance Bond, CO-10, Form # DGS-30-084, and the Terms and Conditions therein.

(d) If it should be judicially determined that the Owner improperly terminated this Contract for cause, then the termination shall be deemed to be a termination for the convenience of the Owner.

(e) Termination of the Contract under this Section is without prejudice to any other right or remedy of the Owner.

42. TERMINATION BY OWNER FOR CONVENIENCE

(a) Owner may terminate this Contract, in whole or in part, at any time without cause upon giving the Contractor written notice of such termination pursuant to Section 1 ("Notice") of these General Conditions. Upon such termination, the Contractor shall immediately cease Work and remove from the Site all of its labor forces and such of its materials as Owner elects not to purchase or to assume in the manner hereinafter provided. Upon such termination, the Contractor shall take such steps as Owner

may require to assign to the Owner the Contractor's interest in all Subcontracts and purchase orders designated by Owner. After all such steps have been taken to Owner's satisfaction, the Contractor shall receive as full compensation for termination and assignment the following:

(1) All amounts then otherwise due under the terms of this Contract,

(2) Amounts due for Work performed in accordance with the Contract subsequent to the latest approved Schedule of Values and Certificate for Payment (Form CO-12) through the date of termination,

(3) Reasonable compensation for the actual cost of demobilization incurred by the Contractor as a direct result of such termination. The Contractor shall not be entitled to any compensation or damages for lost profits or for any other type of contractual compensation or damages other than those provided by the preceding sentence. Upon payment of the foregoing, Owner shall have no further obligations to Contractor of any nature.

(b) In no event shall termination for the convenience of the Owner terminate the obligations of the Contractor's surety on its payment and performance bonds.

43. DAMAGES FOR DELAYS; EXTENSION OF TIME

(a) If the Contractor is delayed at any time in the progress of the Work by any act or omission of the Owner, its agents or employees or any separate independent contractor of the Owner, and the act or omission is the result of or is necessitated by causes outside the Owner's control; or if the Contractor is delayed by strikes, fires, unusual delays in transportation or unavoidable casualties, or other causes outside the Owner's or Contractor's control, the Contractor shall give the Owner and Architect/Engineer written notice within ten (10) days of the inception of the delay. The Owner shall extend the time for Substantial Completion or Final Completion, as the case may be, for the length of time that the Substantial Completion or Final Completion of the Work was actually delayed thereby, and the Contractor shall not be charged with liquidated or actual damages for delay during the period of such extension nor shall the Contractor be due compensation or damages of any kind, under any theory of law, as a result of such delay, the impact of such delay, or acceleration of Work as a result of such delay. In the event a CPM schedule is required by the Contract, no extension of the time allowed for Substantial Completion shall be granted unless the Contractor demonstrates a delay in the critical path of the approved CPM schedule or approved bar graph schedule.

(b) If the Contractor is delayed at any time in the progress of the Work by any act or omission of the Owner, its agents or employees, due to causes within their control, or delayed by the Owner's separate, independent contractors, when such delay results from causes within the Owner's control, and the Contractor intends to seek additional compensation for damages, if any, caused by the delay, the Contractor shall inform the Owner and the Architect/Engineer immediately at the time of the occurrence giving rise to the delay by the fastest means available and shall give written notice no later than two (2) working days after inception of the delay. The Contractor's notice to the Owner shall specify the nature of the delay claimed by the Contractor, the cause of the delay and the impact of the delay on the Contractor's Work schedule. The Owner shall then have three (3) working days to respond to the Contractor's notice with a resolution, remedy or direction to alleviate the delay or with a notice rejecting the claim for delay alleged to be caused by the Owner or parties for whom the Owner is responsible. If the issue is not then resolved, the Contractor may submit a request for Change Order in accordance with Sections 38 and 39 or submit a claim as provided for in Section 47. The Contractor shall only be entitled to additional compensation if the delay was unreasonable and was caused solely by acts or omissions of the Owner, its agents or employees, due to causes within their control, or was caused by the Owner's separate, independent contractor, when such delay resulted solely from causes within the Owner's control.

(c) The Contractor shall not be entitled to an extension of the Time for Completion or Contract Completion Date or to any additional compensation for delays caused by acts or omissions of the Contractor due to causes within his control, including, but not limited to, delays resulting from Defective Work including workmanship and/or materials, from rejected work which must be corrected before dependent work can proceed, from

Defective Work or rejected work for which corrective action must be determined before like work can proceed, or from incomplete, incorrect or unacceptable Submittals or samples.

(d) No extension of time or additional compensation, if applicable, will be granted for any delay unless the claimed delay directly affects the critical path of the approved CPM schedule or the schedule shown on the approved bar graph schedule, whichever is applicable, and any float has been consumed. No extension of time or additional compensation shall be given for a delay if the Contractor failed to give notice in the manner and within the time prescribed in Subsections (a) or (b) above, whichever applies. Furthermore, no extension of time or additional compensation shall be given for any delay unless a claim therefor is made in writing to the Owner, with a copy to the Architect/Engineer, within twenty (20) days of the end of the delay. The claim shall state the cause of the delay, the number of days of extension requested and any compensation requested by the Contractor. The Contractor shall report the termination of the delay to the Owner and Architect/Engineer not less than ten (10) days after such termination. Failure to give notice of either the inception or the termination of the cause of delay or failure to present a claim for extension of time and/or monetary compensation within the times prescribed shall constitute a waiver of any claim for extension or additional compensation based upon that cause.

(e) Requests for compensation for delays pursuant to Subsection (b) above must be substantiated by itemized data and records clearly showing that the Work delayed was on the critical path of the approved CPM schedule or on the sequence of Work on the approved bar graph schedule, as modified, and that the additional costs incurred by the Contractor are directly attributable to the delay in the Work claimed. Furthermore, compensation for delay shall be calculated from the contractual Time for Completion or Contract Completion Date, as adjusted by Change Order, and shall not be calculated based on any early completion planned or scheduled by the Contractor, unless a Change Order has been executed pursuant to Section 19(f) changing the Time for Completion or the Contract Completion Date to reflect such early completion. See Section 19 for procedures for the Contractor to follow if he plans early completion of the Work and wishes to request a Change Order reflecting the early completion date.

If there is an extension in the Time for Completion or the Contract Completion Date and if the Contractor is entitled to compensation under Subsection 43 (b), and where there is no change in the Work, an itemized accounting of the following direct Site overhead expenses will be considered as allowable costs to be used in determining the compensation due the Contractor:

> Site superintendent prorata salary, temporary Site office expense, temporary Site facilities, and temporary Site utilities including basic telephone service, electricity, heat, water, and sanitary/toilets. A fifteen percent (15%) markup of these expenses will be allowed to compensate the Contractor for home office and other direct or indirect overhead expenses.

(f) If the Contractor submits a claim for delay damages pursuant to Subsection 43(b) above, the Contractor shall be liable to the Owner for a percentage of all costs incurred by the Owner in investigating, analyzing, negotiating and litigating the claim, which percentage shall be equal to the percentage of the Contractor's total delay claim which is determined through litigation to be false or to have no basis in law or in fact. (§ 2.2-4335., Code of Virginia)

(g) Any change in the Contract Time for Completion or Contract Completion Date shall be accomplished only by issuance of a Change Order.

(h) If the Contractor fails to complete the Work within the Time for Completion or the Contract Completion Date, the Contractor shall be liable to the Owner in the amounts set forth in the Supplemental General Conditions, if any, not as a penalty, but as fixed, agreed and liquidated damages for delay until the Work is substantially or finally completed as the case may be. If liquidated damages are not so fixed in the Supplemental General Conditions, the Contractor shall be liable for any and all actual damages sustained as a result of delay. In addition to damages for delay, whether liquidated or actual, the Contractor shall also be liable for any and all actual damages sustained by the Owner as a result of any other breach of the Contract, including, but not limited to, Defective Work and abandonment of the Contract.

(i) If liquidated damages are provided by the Supplemental General Conditions, the following provisions apply:

(1) If the Work is not substantially complete by the Time for Completion or Contract Completion Date, the Contractor shall owe to the Owner, not as a penalty but as Step One liquidated damages, the sum

stated in the Supplemental General Conditions for Step One liquidated damages for each and every partial or total calendar day of delay in Substantial Completion.

(2) Once the Work is substantially complete, the accrual of Step One liquidated damages shall cease and the Contractor shall have thirty (30) calendar days in which to achieve Final Completion of the Work.

(3) If Final Completion of the Work is not achieved on or before the thirtieth (30th) calendar day after Substantial Completion, and if the Owner has not granted any extension of time, the Contractor shall owe to the Owner, not as a penalty but as Step Two liquidated damages, the sum stated in the Supplemental General Conditions as Step Two liquidated damages for each and every partial or total calendar day of delay in Final Completion.

44. INSPECTION FOR SUBSTANTIAL COMPLETION & FINAL COMPLETION

(a) The Contractor shall notify the Owner, in writing on the Certificate of Partial or Substantial Completion by the Contractor (Form CO-13.2a), of the date when the Work or designated portion thereof, will be, in his opinion, substantially complete and ready for inspection and testing to determine if it has reached Substantial Completion. The notice shall be given at least ten (10) days in advance of said date and shall be forwarded through the Architect/Engineer, who will attach his written endorsement as to whether or not he concurs with the Contractor's statement that the Work will be ready for inspection and testing on the date given. The Architect/Engineer's endorsement is a convenience to the Owner only and shall not relieve the Contractor of his responsibility in the matter nor shall the Architect/Engineer's endorsement be deemed to be evidence that the Work was substantially complete and ready for inspection and testing. Inspection and testing shall take place at a time(s) mutually agreeable to the Contractor, Owner and Architect/Engineer.

The inspection shall include a demonstration by the Contractor that all equipment, systems and operable components of the project function properly and in accordance with the Contract Documents. The Contractor shall furnish access for the inspection and testing as provided in Section 21 of these General Conditions. The inspection and testing shall determine whether Substantial Completion has been accomplished and shall result in a written list of unfinished Work and Defective Work, commonly referred to as a "punch list", which must be finished and corrected to obtain Final Completion.

After successful completion of the testing and the Architect / Engineer determines that, in its opinion, the Work, either in whole or in part, is substantially complete, the Architect / Engineer shall notify the Owner, in writing on the Certificate of Partial or Substantial Completion by the Architect/Engineer (Form CO-13.1a), that the Work, or a specified portion thereof, is recommended to be declared substantially complete. The Owner shall notify the Contractor, in writing, of the date the Owner accepts the Work, or the specified portion thereof, as substantially complete or the Owner shall notify the Contractor of the deficiencies to be corrected or completed before such Work will be accepted as substantially complete.

(b) The Contractor shall notify the Owner, in writing on the Certificate of Completion by the Contractor (form CO-13.2), of the date when the Work has reached or will reach Final Completion and will be ready for final inspection and testing. The notice shall be given at least five (5) days in advance of said date and shall be forwarded through the Architect/Engineer, who will attach his endorsement as to whether or not he concurs in the Contractor's statement that the Work will be ready for inspection and testing on the date given. That inspection and any necessary testing shall be conducted in the same manner as the inspection for Substantial Completion. When the Work is finally and totally complete, including the elimination of all defects, the Work shall be finally accepted by the Owner and final payment shall be made in accordance with Section 36 of these General Conditions.

(c) The Architect/Engineer shall conduct the inspections. The Owner may elect to have other persons of its choosing also participate in the inspections. If one or more Substantial or Final Completion reinspections are required, the Contractor shall reimburse the Owner for all costs of reinspection or, at the Owner's option, the costs may be deducted from payments due to the Contractor.

(d) A representative of the State Fire Marshal's Office will either be present at the Substantial and Final Completion inspections or otherwise inspect the completed Work and advise the Owner whether the Work meets the fire safety requirements of the applicable building code.

(e) Approval of Work at or as a result of any inspection required herein shall not release the Contractor or his surety from responsibility for complying with the Contract.

45. GUARANTEE OF WORK

(a) Except as otherwise specified, all Work shall be, and is hereby, guaranteed by the Contractor against defects resulting from the use of materials, equipment or workmanship, which are defective, inferior, or not in accordance with the terms of the Contract, for one (1) year from the date of Final Completion of the entire Project by the Owner. Equipment and facilities which have seasonal limitations on their operation (e.g. heating or air conditioning units) shall be guaranteed for one (1) full year from the date of seasonally appropriate tests and acceptance, in writing, by the Owner. Where the Owner agrees to take Beneficial Occupancy of a portion or phase of the Work which has been determined to be substantially complete before the entire Work is finally completed, the guarantees for the materials, equipment and workmanship in that portion or phase shall begin on the date that the Owner takes Beneficial Occupancy, unless otherwise specified in the Supplemental General Conditions, Special Conditions, or by separate agreement.

(b) If, within any guarantee period, Work which is not in accordance with the Contract, Defective Work, or inferior material, equipment or workmanship is noted by the Owner or Architect/Engineer which requires or renders necessary repairs or changes in connection with the guaranteed Work, the Contractor shall, promptly upon receipt of notice from the Owner, such notice being given not later than two weeks after the guarantee period expires, and without expense to the Owner:

(1) Place in satisfactory condition in every particular all of such guaranteed Work and correct all defects, inferior materials, equipment or workmanship therein;

(2) Make good all damage to the structure or Site or equipment or contents thereof, which, in the opinion of the Owner or the Architect/Engineer, is the result of the use of materials, equipment or workmanship which are inferior, defective or not in accordance with the terms of the Contract; and

(3) Make good any Work or materials or the equipment and contents of structures and/or Site disturbance that results from fulfilling the provisions of this Section.

(c) In any case, when in fulfilling the requirements of the Contract and this guarantee or any other guaranty or warranty, the Contractor disturbs any work performed by a separate contractor, he shall restore such work to a condition satisfactory to the Architect/Engineer and Owner and guarantee such restored work to the same extent as if it was guaranteed under this Contract.

(d) If the Contractor, after notice, fails to proceed promptly to comply with the terms of the guarantee as set forth in this Section, the Owner may have the defects or inferior materials, equipment or workmanship corrected and the Contractor and his surety shall be liable for all expense incurred.

(e) All special warranties and guarantees applicable to definite parts of the Work that may be stipulated in or required by the Contract Documents shall be subject to the terms of this Section during the first year of the life of such special warranty or guarantee.

(f) The guarantee of this Section shall be in addition to and not in lieu of all other warranties, express or implied, applicable to or arising from this Contract or by law.

(g) Nothing contained in this Section shall be construed to establish a period of limitation with respect to any other obligation which the Contractor might have under the Contract Documents, including liability for Defective Work under Section 30. This Section relates only to the specific obligation of the Contractor as set forth in this Section to correct the Work and does not limit the time within which his obligation to comply with the Contract Documents may be sought to be enforced, nor the time within

which proceedings may be commenced to establish the Contractor's liability with respect to his other obligations under the Contract Documents.

(h) In the event the Work of the Contractor is to be modified by another contractor, either before or after the Final Inspection provided by Section 44 of the General Conditions, the first Contractor shall remain responsible in all respects under this Section's Guarantee of Work and under any other warranties or guarantees, express or implied, applicable to or arising from this Contract or by law. However, the Contractor shall not be responsible for any defects in material or workmanship introduced by the contractor modifying his Work. The first Contractor and the contractor making the modifications shall each be solely responsible for his respective work. The contractor modifying the earlier Work shall be responsible for any damage to or defect introduced into the Work by his modification. If the first contractor claims that a subsequent contractor has introduced defects of materials and/or workmanship into his Work, it shall be the burden of the contractor making the claim to demonstrate clearly the nature and extent of such introduced defects and the other contractor's responsibility for those defects. Any contractor modifying the work of another shall have the same burden if he asserts that defects in his work were caused by the contractor whose work he is modifying.

46. ASSIGNMENTS

Neither party to the Contract shall assign the Contract in whole or any part without the written consent of the other, nor shall the Contractor assign any moneys due or to become due to him hereunder, without the prior written consent of the Owner. Consent to assignment shall not be unreasonably withheld. No assignment shall relieve any party from its obligations under the Contract.

47. CONTRACTUAL DISPUTES (§2.2-4363, Code of Virginia)

Contractual claims, whether for money or for other relief, shall be submitted, in writing, no later than sixty (60) days after final payment; however, written notice of the Contractor's intention to file such claim must be given at the time of the occurrence or beginning of the Work upon which the claim is based. The filing of a timely notice is a prerequisite to recovery under this Section. Although the Contractor may be required to submit certain classes of claims prior to final payment, and the Contractor is not prevented from filing claims during the pendency of the Work, the Owner shall not be obligated to render a final written decision on any claim until after final payment. All claims shall be submitted along with all practically available supporting evidence and documentation.

No written decision denying a claim or addressing issues related to the claim, if rendered prior to final payment, shall be considered a denial pursuant to this Section unless the written decision makes express reference to this Section and is signed by the Agency head or his designee. The Contractor may not institute legal action prior to receipt of the Owner's final written decision on the claim unless the Owner fails to render such a decision within ninety (90) days of submission of the claim or within ninety (90) days of final payment, whichever is later.

The decision of the agency head or other signatory on the Contract shall be final and conclusive unless the Contractor within six (6) months of the date of the final decision on a claim, initiates legal action as provided in §2.2-4364 of the Code of Virginia. Failure of the Owner to render a decision within 90 days shall not result in the Contractor being awarded the relief claimed nor shall it result in any other relief or penalty. The sole result of the Owner's failure to render a decision within 90 days shall be the Contractor's right to immediately institute legal action. No administrative appeals procedure pursuant to §2.2-4365 of the Code of Virginia has been established for contractual claims under this Contract.

Pursuant to § 2.2-4366, Alternative Dispute Resolution, of the Code of Virginia, the Owner may enter into an agreement with the Contractor to submit disputes arising from the performance of this Contract to arbitration and utilize mediation and other alternative dispute resolution procedures. **However**, such procedures entered into by the Owner, the Commonwealth, or any department, institution, division, commission, board or bureau thereof, shall be non-binding and subject to § 2.2-514, as applicable.

48. ASBESTOS

(a) This subsection applies to projects involving existing buildings where asbestos abatement is not a part of the Work, when the scope of the project has been reviewed and a comprehensive survey conducted by an individual licensed by the Virginia Department of Professional and Occupational Regulation to

conduct building inspections for asbestos containing materials in buildings, and where the Owner has attempted to remove or encapsulate all asbestos containing material that may become friable or damaged during this Project.

Prior to commencement of Work, the results of the comprehensive survey or any other asbestos survey shall be made available to the Contractor, who shall be responsible for performing his Work so as not to disturb any remaining asbestos, encapsulated or otherwise, identified in such survey or surveys.

If the Contractor discovers or inadvertently disturbs any material that he knows, should have known or has reason to believe, may contain asbestos that has not been previously identified, was overlooked during the removal, was deemed not to be friable or was encapsulated, the Contractor shall stop Work in the area containing or suspected to contain the asbestos, secure the area, and notify the Owner and the Architect/Engineer immediately by telephone or in person with written notice as soon as possible. The Owner will have the suspect material sampled.

If the sample is positive and must be disturbed in the course of the Work, the Owner shall have the material repaired or removed and shall pay for the bulk sample analysis.

Except as provided in §11-4.1 of the Code of Virginia, if the material disturbed is not within the Contractor's authorized Work and/or Work area or under this Contract, the Contractor shall pay for all associated sampling and abatement costs.

(b) If asbestos abatement is included as a part of the Work, the Contractor shall assure that the asbestos abatement work is accomplished by those duly licensed as described in Section 3 of these General Conditions and in accordance with the specific requirements of the Contract and all applicable laws and regulations.

(c) If asbestos abatement is included as part of the Work, the licensed asbestos Subcontractor shall obtain the insurance required under Section 11 (e) of these General Conditions.

49. TRAINING, OPERATION AND MAINTENANCE OF EQUIPMENT

(a) As a part of the Work, the Contractor in conjunction with his Subcontractors and Suppliers shall provide the Owner's operations and maintenance personnel with adequate instruction and training in the proper operation and maintenance of any equipment, systems, and related controls provided or altered in the Work. The training requirements may be further defined in the specifications.

(b) The Contractor shall provide the Owner with a minimum of two (2) copies of operating, maintenance and parts manuals for all equipment and systems provided in the Work. Further specific requirements may be indicated in the specifications.

50. PROJECT MEETINGS

(a) The intention of this Section is that the Contractor, the Owner and the A/E have timely exchange of information and cooperate to accomplish the Work as required by the Contract Documents. The Contractor is responsible for managing the Work, obtaining approvals and requesting clarifications on a timely, reasonable basis. The Owner and its A/E are responsible for making a reasonable effort to provide timely responses to the Contractor.

(b) **Preconstruction Meeting:**
Prior to the start of construction and no later than 15 calendar days after the Notice to Proceed, a "Preconstruction" meeting shall be held with attendees to include the Owner's Project Manager and Project Inspector, the Architect/Engineer's project manager and representatives of each design discipline involved in the Project, the Regional Fire Marshal, the Contractor's project manager and superintendent (and scheduler, if Contractor desires), and representatives of the Contractor's major Subcontractors. The purpose of the meeting is to clarify and discuss the specifics related to, but not limited to, the following:

(1) Persons involved from each entity and their chain of authority including the names of persons authorized to sign Change Orders and any limits to their authority. Name of Contractor's on-site certified Responsible Land Disturber.

(2) Names, addresses, telephone numbers and FAX numbers to be used for Requests for Information (RFI), Requests for Clarification (RFC), Requests for Proposals (RFP), shop drawings, Submittals, and notices.

(3) Contractor's proposed construction schedule and Owner's sequencing requirements, if any.

(4) Schedule of Values and Certificate for Payment (Form C0-12) requirements and procedures.

(5) Procedures for shop drawings, product data and Submittals.

(6) Procedures for handling Field Orders and Change Order Form C0-11.

(7) Procedures for Contractor's request for time extension, if any.

(8) Construction Site requirements, procedures and clarifications to include:
- Manner of conducting the Work
- Site specialities such as dust and erosion control, stormwater management, project signs, clean up and housekeeping, temporary facilities, utilities, security, and traffic
- Safety
- Layout of the Work
- Quality control, testing, inspections and notices required
- Site visits by the A/E and others
- Owner's Project Inspector duties
- Running Punch List
- As-Built Drawings

(9) Procedures and documentation of differing or unforeseen Site conditions

(10) Monthly Pay Meeting

(11) Project Close-Out requirements and procedures

(12) Project records

(c) **Monthly Pay Meeting:**
Section 36 establishes the requirement for a monthly pay meeting which will usually be held at or near the Site. In addition to Owner, A/E and Contractor representatives, the following representatives, at a minimum, should be available to attend portions of the meeting, as applicable or necessary:
- Owner's Project Inspector
- Contractor's project superintendent
- A/E representative of each discipline where Work was performed for the current pay request or where Work is projected to be performed in the coming month.
- A representative of each subcontractor who performed work included in the current pay request.
- A representative of each subcontractor who is projected to perform work in the coming month.

The following topics should be included, as a minimum, in the monthly pay meeting:

(1) Observations of status, quality and workmanship of Work in progress

(2) Validation of the Schedule of Values and Certificate for payment

(3) Conformance with proposed construction schedule

(4) Outstanding Requests for Information, Requests for Clarification and Requests for Proposal

(5) Submittals with action pending

(6) Status of pending Change Orders

(7) Status of Running Punch List items

(8) Work proposed for coming pay period

(9) Discussions of any problems or potential problems which need attention

(d) **Other Meetings:**
Requirements for other meetings, such as progress meetings, coordination meetings, pre-installation meetings and/or partnering meetings, may be included in the Contract Documents.

* * * END OF GENERAL CONDITIONS * * *

SUPPLEMENTAL GENERAL CONDITIONS

THE COMMONWEALTH OF VIRGINIA GENERAL CONDITIONS of the Construction Contract, G. S. Forms CO-7 (2004 edition) (Rev 06/04) are modified and supplemented as hereinafter described.

1. Add the following Section 51 to the General Conditions of the Construction Contract:

"51. Small Businesses and Women-Owned and Minority-Owned (SWAM) Business Procurement Plan

The Owner has developed a "SWAM" plan for increasing procurement from small, women-owned, and minority-owned (SWAM) businesses in its construction program. The Owner's SWAM aspirational goals and plan are included in the contract documents for use by the Contractor in developing its plan for involving small, women-owned, and minority-owned (SWAM) businesses thru subcontracting, and thru the purchasing of goods, materials, supplies and services in the Contractor's construction program. The Owner's plan provides criteria and goals for the Contractor in developing a plan, for submitting its plan and for reporting its achievements in meeting the goals established for the Contract.

The Contractor shall, as soon as practicable after the signing of the contract but not later than 30 days after the effective date of the contract, provide a list of Subcontractors that are proposed to perform the work, including SWAM subcontractors, vendors and suppliers showing their DMBE certification numbers where applicable.. Upon receipt of the list, the Owner may, based on the Agency SWAM Procurement Plan require the Contractor to provide additional information on work that has been bid by SWAM contractors, and areas in which the scope of work may be reduced in size to increase the pool of potential SWAM contractors. Selection of particular Subcontractors for a certain part of the work shall be made in accord with Section 9, Subcontracts of the General Conditions.

MINORITY/WOMEN OWNED BUSINESSES SUBCONTRACTING AND REPORTING:
Where it is practicable for any portion of the awarded contract to be subcontracted to other suppliers, the contractor is encouraged to offer such business to minority and/or women-owned businesses. Names of firms may be available from the buyer and/or from the Division of Purchases and Supply. When such business has been subcontracted to these firms and upon completion of the contract, the contractor agrees to furnish the purchasing office the following information: name of firm, phone number, total dollar amount subcontracted and type of product/service provided. See specific requirements in the Owner's SWAM plan.
In the case of construction contracts awarded to non-SWAM primes, the prime contractor shall seek to size the subcontracts so as to enable qualified SWAM subcontractors to bid effectively for such work so long as the effect of reducing the size of such subcontracts does not cause a meaningful increase in price or a significant degradation in terms, conditions or other applicable contract factors.

Form AS-42
(Revised 10/25/04)

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF TRANSPORTATION

SUPPLEMENT TO THE GENERAL CONDITIONS OF THE
CONSTRUCTION CONTRACT
G. S. Form E & B CO-7

The following material adds to, modifies, or changes items in the General Conditions of the Construction Contract.

1. CONTRACT DOCUMENTS (General Conditions, Section No. 2)

   Section No .2 (d): In the last sentence following "Contract Between the Owner and Contractor, add "Invitation for Bid with Addenda (if applicable):"

2. ”ALL RISK" BUILDER 'S RISK INSURANCE (General Conditions, Section No. 12).

   Section No. 12 (c): In the next to the last sentence following "The Supplemental General Conditions" add "or the Invitation for Bid".

3. FEES, SERVICES AND FACILITIES: (General Conditions, Section No. 25)

   The following item (f) is added to Section No. 25:

   (f) All temporary Work such as named above and barricades, hoisting elevators, etc., shall be completely removed from the Site at the completion of the project.

4. STANDARDS FOR MATERIAL AND INSTALLATION AND WORKMANSHIP: (General Conditions, Section No. 29)

   The following item (h) is added to Section No. 29:

   (h) The Contractor shall provide Owner the name and address of firm(s) that installed designated equipment or operating systems.

5. USE OF SITE AND REMOVAL OF DEBRIS: (General Conditions, Section No. 31)

   General Conditions, Section No. 31 (e): The last sentence is replaced by the following:

The contractor shall prevent Site soil erosion, the runoff of silt and/or debris carrying water from the Site,-and the blowing of debris off the Site in accordance with the applicable requirements and standards of the Contract, the latest edition of the Virginia Department of Transportation Road and Bridge Specifications. the Virginia Department of Conservation and Recreation's Erosion and Sediment Control Regulations and the Virginia Storm water Management Regulations.

6. DAMAGES FOR DELAYS, EXTENSION OF TIME: (General Conditions, Section No. 43).

Section 43 (i), following "If Liquidated damages are provided by the Supplemental General Conditions" add "or the Invitation for Bid".

7. TRAINING OPERATION AND MAINTENANCE OF EQUIPMENT: (General Conditions, Section No. 49)

General Conditions, Section 49 (b) are replaced by the following:

(h) Operating Manual: At the time of completion, the Contractor shall furnish to the Owner three (3) loose-leaf books containing complete operating, parts and maintenance instructions for all mechanical and electrical equipment in the project, together with the names and addresses of the applicable Subcontractor and Suppliers.

The Contractor shall also furnish to the Owner three (3) complete sets of mechanical and electrical prints of final corrected and approved shop drawings and submittal data. Guarantee: The use of permanent building equipment for temporary heat or air conditioning or other construction services shall in no way affect the guarantee period for equipment. Further specific requirements may be indicated in the specifications.

8. CONSTRUCTION SAFETY AND HEALTH

It is a condition of the Contract, and shall be made a condition of each subcontract entered into pursuant to the Contract, that the Contractor and any Subcontractor shall not require any worker employed in performance of the Contract to work in surroundings or under work conditions that are unsanitary, hazardous, or dangerous to their health or safety, as determined under Construction Safety and Health Standards promulgated by the U.S. Secretary of Labor in accordance with Section 107 of the Contract Work Hours and Safety Standards Act.

The Contractor shall comply with the Virginia Occupational Safety and Health Standards adopted under Section 40.1-22 of the Code of Virginia and the duties imposed under Section 40.1-51.1 of the code of Virginia. Any violation of the requirements or duties that is brought to the attention of the Contractor by the Architect or any other person shall be immediately abated.

COMMONWEALTH OF VIRGINIA
CONTRACT BETWEEN OWNER AND CONTRACTOR

This Contract, dated this _____ day of _____, 2005 between _____ ("Owner") and _____ ("Contractor"), is binding among and between these parties as of the date of the Owner's signature.

RECITALS

1. The legal address for the Owner and for the Contractor and the addresses for delivery of Notices and other project documents are as follows:

Owner: Virginia Department of Transportation
Asset Management Division

Attn: Jacob A. Porter, Special Facilites Program Manager
Address: 1401 East Broad Street
City, State, Zip: Richmond, VA 23219
Telephone: (804) 662-9615 FAX: (804) 662-9407

Contractor:

Attn:
Address:
City, State, Zip:
Telephone: FAX:
Contractor's Virginia License #:
FEIN/SSN:

2. The Project is identified as:

Project Title: New Kent Safety Rest Area & Information Center I-64W
Project Code – PC#: 501-06501-005
General Project Description: LEED Silver Certified Replacement of Rest Area Facilities

The Project Code (PC#) indicated above is required to be shown for identification purposes on all project-related material and documents including but not limited to, Notices, Change Orders, Submittals, Requests For Information, Requests For Quotes, Field Orders, minutes of meetings, correspondence, Schedule of Values and Certificate For Payment (Form CO-12), test reports, and related materials.

3. After competitive sealed bidding pursuant to the Virginia Public Procurement Act, Contractor is awarded this Contract to perform the Work described by the Contract Documents for the above-described project ("the Project").

THEREFORE, in consideration of the Recitals set forth above, and good and valuable consideration as set forth below, the parties agree as follows:

1. STATEMENT OF WORK: The Contractor shall furnish all labor, equipment, and materials and perform all Work for the Project in strict accordance with the Contract Documents.

2. CONTRACT DOCUMENTS: This Contract shall consist of the following:

- this Contract Between Owner and Contractor (Form CO-9);
- the Bid Form submitted by the Contractor;
- Post Bid Modification(s), if any, dated _____;
- the General Conditions of the Construction Contract (Form CO-7), (referred to as the "General Conditions")
- the Supplemental General Conditions, if any;
- the Special Conditions attached to the Owner's Invitation for Bids;
- the Owner's Project Plans and Specifications dated August 3, 2006;
-
-
-

All of these documents are incorporated herein by reference.

3. TIME FOR COMPLETION: The Work shall be commenced on a date to be specified in a written order of the Owner and shall be Completed (Final Completion) not later than the Contract Final Completion Date which is June 9, 2007. The Contractor shall obtain a date of Substantial Completion as determined by the A/E prior to Final Completion.

4. COMPENSATION TO BE PAID TO THE CONTRACTOR: The Owner agrees to pay and the Contractor agrees to accept as just and adequate compensation for the performance of the Work in accordance with the Contract Documents the sum of
_____dollars ($_____).

INCENTIVE/DISINCENTIVE CLAUSES:
If the Contractor completes the project, in its entirety (Final Completion), by **April 10, 2007**, the Contractor is entitled to an early completion incentive of $300,000 payable by the Department. No incentive payments or portions thereof are offered for project completion past **April 10, 2007**.

If the Contractor completes the project, in its entirety, by **April 10, 2007** and elects to receive the early completion incentive payment, the Contractor shall notify the Department in writing within 5 calendar days after project completion of such election. The Contractor's incentive payment election notification

shall be documented by executing the "Early Completion Incentive and Release of All Claims" form which is included in the Project Manual. This form shall be signed and certified by the Contractor to be all-inclusive, final, and absolute, except any routine final estimating quantity adjustments at the sole discretion of the Department. If such notification and properly executed form is not received by the Department within 5 calendar days of the actual date of early project completion, the Contractor is not eligible for the incentive payment.

The mandatory project completion date for this contract is **June 9, 2007**. If the **June 9, 2007** mandatory project completion date is not met by the Contractor, a disincentive of $5,000 for each full day past **June 9, 2007** for which the project is not complete will be deducted from the total contract price until the date of actual project completion or a maximum of 60 calendar days. Project completion is determined at the sole discretion of the Department. Such disincentive and corresponding deductions from the total contract price shall not constitute a penalty or damage in any form. If the project is not complete within 60 calendar days of the mandatory project completion date, the Contractor will be in default of the Contract. Such disincentive shall not preclude the Department from taking any other Contract actions or measures as necessary to ensure contract compliance.

Upon award of contract, the Contractor fully acknowledges and agrees that the disincentive clause, the Department's action to exercise the disincentive clause, and any corresponding deductions from the total contract price do not constitute a penalty or damage in any form. Further, the Contractor agrees that no causes, claims, disputes, damages, suits, or any other actions will be taken or filed against the Department for any such disincentives and corresponding deductions from the total contract price.

5. PAYMENTS: The procedures for establishing a Schedule of Values for the Work, for requesting monthly progress payments for Work in place, and for requesting payments for properly stored materials are stated in the General Conditions. Unless otherwise provided under the Contract Documents, interest on payments due the Contractor shall accrue at the rate of one percent per month. §2.2-4354 of the Code of Virginia.

6. CONTRACTUAL CLAIMS: Any contractual claims shall be submitted in accordance with the contractual dispute procedures set forth in Section 47 of the General Conditions and the supplemental instructions or procedures of the contracting State Agency, if any, attached to this Contract.

7. NON-DISCRIMINATION: §2.2-4311 of the Code of Virginia applies to this contract. See Section 4 of the General Conditions.

IN WITNESS WHEREOF, the parties hereto on the day and year written below have executed this agreement in three (3) counterparts, each of which shall, without proof or accountancy for the other counterparts, be deemed on original thereof.

For the CONTRACTOR: **For the OWNER:**

By: _____ By: _____
(signature in ink) *(date)* *(signature in ink)* *(date)*

_____	_____
(typed name)	*(typed name)*
_____	_____
(typed title)	*(typed title)*
Attest:	Attest:
_____	_____
(signature in ink) *(date)*	*(signature in ink)* *(date)*

Attachments:

- Bid Form Submitted by the Contractor
- Post Bid Modification, if any

COMMONWEALTH OF VIRGINIA
WORKERS' COMPENSATION
Certificate of Coverage

Section 2.2-4332, Code of Virginia, requires construction contractors and subcontractors to obtain and maintain workers' compensation insurance while performing work on behalf of the Commonwealth of Virginia, its departments, institutions, or agencies. This same requirement applies on behalf of local governments.

Evidence of coverage must be provided prior to commencement of Work.

This form must be completed and returned to the organization contracting the Work.

The undersigned organization stipulates that it:

A. has workers' compensation insurance and is in compliance with the Workers' Compensation statutes of the Commonwealth of Virginia. _____ Yes _____ No
Insurance Company _____
Policy expiration date _____

B. is self insured for workers' compensation. _____ Yes

Title of Construction Contract: _____

_____

Contract Number: _____

Signed by: _____

Title: _____

Firm Name: _____

Address: _____

_____

_____

COMMONWEALTH OF VIRGINIA
STANDARD PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: That _____, the Contractor ("Principal") whose principal place of business is located at _____ and _____ ("Surety") whose address for delivery of 'Notices' is located at _____ are held and firmly bound unto the Commonwealth of Virginia, _____, the Owner ("Obligee") in the amount of _____ Dollars ($ _____) for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS,

Principal has by written agreement dated _____ entered into a contract with Obligee _____ which contract (the "Contract") is by reference expressly made a part hereof;

NOW THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if the Principal shall promptly and faithfully perform said Contract in strict conformity with the plans, specifications and conditions of the Contract, then this obligation shall be null and void; otherwise it shall remain in full force and effect.

Provided, that any alterations which may be made in the terms of the Contract, or in the Work to be done under it, or the giving by the Obligee of any extension of time for the performance of the Contract, or any other alterations, extensions or forbearance on the part of either or both of the Obligee or the Principal to the other shall not in any way release the Principal and the Surety, or either of them, their heirs, executors, administrators, successors or assigns from their liability hereunder, notice to the Surety of any such alterations, extension, or forbearance being hereby waived.

No action shall be brought on this bond unless brought within one year after: (a) completion of the Contract and all Work thereunder, including expiration of all warranties and guarantees, or (b) discovery of the defect or breach of warranty or guarantee if the action be for such.
The Surety represents to the Principal and to the Obligee that it is legally authorized to do business in the Commonwealth of Virginia.

Signed and sealed this _____ day of _____

_____
Contractor / Principal **(SEAL)**

By:_____
Typed Name: _____
Title: _____

_____
Witness

_____
Surety **(SEAL)**

By:_____
Attorney-in-Fact
Typed Name: _____

AFFIDAVIT AND ACKNOWLEDGEMENT OF ATTORNEY-IN-FACT

COMMONWEALTH OF VIRGINIA
(or alternatively, Commonwealth or State of _____)

CITY of _____

I, the undersigned notary public, do certify that _____, whose name is signed to the foregoing performance bond in the sum of _____ and dated _____ and which names the Commonwealth of Virginia, _____, as Obligee, personally appeared before me today in the above jurisdiction and made oath that he/she is the attorney-in-fact of _____, a _____ corporation which is the Surety in the foregoing bond, that he/she is duly authorized to execute on the above Surety's behalf the foregoing bond pursuant to the Power of Attorney noted above and attached hereto, and on behalf of the surety, he/she acknowledged the foregoing bond before me as the above Surety's act and deed

She/he has further certified that her/his Power of Attorney has not been revoked.
[Complete if Power is recorded: Clerk's Office: _____;
Deed Book/Page No. or Instrument No.: _____.]

Given under my hand this _____ day of _____.

_____
Notary Public (SEAL)

My name (printed) is _____

My commission expires: _____

APPROVED:

_____
Attorney General/Designee Date

Terms and Conditions of the Performance Bond

1 The Contractor and the Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the prompt and faithful performance of the Construction Contract, which is incorporated herein by reference.

2 If the Contractor promptly and faithfully performs the Construction Contract in strict conformity with the plans, specifications and conditions of the Construction Contract, the Surety and the Contractor shall have no obligations under this Bond.

3 In the event of the Contractor's Default, and subsequent notification to the Surety pursuant to Section 41 of the General Conditions of the Construction Contract, the Surety shall, within fourteen (14) days of receipt of such notice, contact the Owner in writing, and arrange a meeting with the Owner to discuss methods of completing the Construction Contract. See paragraph 4, below, for the options to be discussed. If the Surety fails to arrange a meeting or fails to attend such meeting, the Surety shall be deemed to be in default on this Bond and the Owner may, at its sole discretion, take what measures it deems necessary to protect the Owner's interests, without further notice to the Surety, and the Owner shall be entitled to enforce any remedy available to the Owner under the Construction Contract or under Virginia law.

4 Within thirty (30) days after such meeting, during which time the Surety may investigate and otherwise analyze the project, and which period shall not toll any Construction Contract time periods nor operate as a waiver of any of the Owner's rights, the Surety shall, at its own expense, notify the Owner in writing that it is taking one of the following actions, which shall be acceptable to the Owner, at the Owner's sole discretion:

4.1 By written takeover agreement with the Owner, the Surety itself shall undertake to perform and complete the Construction Contract, which it may do through its licensed agents or through licensed independent contractors. If the Owner, at its sole discretion, consents, the Contractor may serve as the Surety's independent contractor (however, due to conflicts with the Virginia Public Procurement Act, the Owner may not directly contract with an otherwise qualified independent contractor produced by the Surety); or

4.2 The Surety may, if acceptable to the Owner and at the Owner's sole discretion, waive its right to perform and complete the Construction Contract, and with reasonable promptness under the circumstances:

4.2.1 Pay to the Owner all amounts for which it may be liable to the Owner as surety on this Performance Bond, including the damages described in paragraph 6 below; or

4.2.2 Deny liability, in whole or in part, and provide written notice thereof to the Owner, citing reasons therefor.

5 If, after the meeting described in paragraph 4, above, the Surety does not proceed with reasonable promptness with one of the options provided in subparagraphs 4.1 or 4.2 (including its subparts), above, the Owner may send additional written notice to the Surety demanding that the Surety perform its obligations under the Bond. If the Surety does not proceed to perform its obligations under the Bond within fifteen (15) days after receipt of said notice, the Surety shall be deemed to be in default on this Bond. Thereafter, the Owner shall be entitled to enforce any remedy available to the Owner under the Bond, the Construction Contract or Virginia law. If the Surety proceeds as provided in Subparagraph 4.2, and the Surety and the Owner are unable to agree as to the amount for which the Surety may be liable to the Owner, or if the Surety has denied liability, in whole or in part, the Owner, without further notice, shall be entitled to enforce any remedy available to the Owner under the Bond, the Construction Contract or Virginia law. In such event, the Owner may immediately proceed to complete the work in any manner authorized by law.

6 After the Owner has terminated the Contractor's right to complete the Construction Contract, and if the Surety elects to act under Subparagraph 4.1 or 4.2.1, above, then the responsibilities of the Surety to the Owner shall not be greater or less than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than or less than those of the Owner under the Construction Contract. To the limit of the amount of this Bond, plus the increased cost of any change orders under the Construction Contract, provided the Owner commits the balance of the Construction Contract Price to the prompt and faithful completion of the Construction Contract, the Surety is obligated without duplication for:

6.1 The responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

6.2 Additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 4; and

6.3 Liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

The Owner, at its sole discretion, may waive its claim to delay costs and/or liquidated damages.

7 The Surety shall not be liable to the Owner for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner, its officers, agencies, administrators, successors or assigns.

8 The Surety hereby waives notice of any changes, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

The Surety understands and agrees that the penal amount of the bond shall be increased or decreased by any changes to time and amount incorporated into any Change Orders.

9 Any proceeding by the Owner, legal or equitable, under this Bond may be instituted in any Virginia state court of competent jurisdiction, as permitted under Section 8 of the General Conditions of the Construction Contract and Virginia Code § 2.2-4337 and 2.2-4340, or by the Contractor or Surety, as permitted under the Construction Contract or under Virginia law.

10 Notice to the Surety shall be mailed or delivered to the address shown on the Standard Performance Bond in the space for Surety address for delivery of Notices

11 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond when furnished to comply with statutory requirements.

12 DEFINITIONS

12.1 **Balance of the Construction Contract Price**: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

12.2 **Construction Contract**: The agreement between the Owner and the Contractor identified on first page of the Standard Performance Bond, DGS-30-084, CO-10, including all Construction Contract Documents and duly executed modifications and change orders thereto.

12.3 **Contractor Default**: Failure of the Contractor, as defined under Section 41 of the General Conditions to the Construction Contract, which has neither been remedied, as permitted under Section 41 at the Owner's sole discretion, nor expressly waived by the Owner, to perform or otherwise to comply with the terms of the Construction Contract.

13 Nothing in these General Conditions shall prevent a surety from becoming involved in the Construction Contract prior to termination, upon notice from the Owner of the Contractor's failure to promptly and faithfully perform the Construction Contract in strict conformity with the plans, specifications and conditions of the Construction Contract.

COMMONWEALTH OF VIRGINIA
STANDARD LABOR AND MATERIAL PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: That _____, the Contractor ("Principal") whose principal place of business is located _____ and _____ ("Surety") whose address for delivery of 'Notices' is located at _____ are held and firmly bound unto the Commonwealth of Virginia, _____, the Owner ("Obligee") in the amount of _____ Dollars ($_____) for the payment whereof Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS,

Principal has by written agreement dated _____ entered into a contract with Obligee for _____ which contract (the "Contract") is by reference expressly made a part hereof;

NOW THEREFORE, THE CONDITION OF THIS OBLIGATION is such that, if the Principal shall promptly make payment to all claimants as hereinafter defined, for labor performed and material furnished in the prosecution of the Work provided for in the Contract, then this obligation shall be void; otherwise it shall remain in full force and effect, subject, however, to the following conditions.

The Principal and Surety, jointly and severally, hereby agree with Obligee as follows:

1. A claimant is defined as one having a direct contract with the Principal or with a subcontractor of the Principal for labor, material, or both for use in the performance of the Contract. A "subcontractor" of the Principal, for the purposes of this bond only, includes not only those subcontractors having a direct contractual relationship with the Principal, but also any other contractor who undertakes to participate in the Work which the Principal is to perform under the aforesaid Contract, whether there are one or more intervening subcontractors contractually positioned between it and the Principal (for example, a subcontractor). "Labor" and "material" shall include, but not be limited to, public utility services and reasonable rentals of equipment, but only for periods when the equipment rented is actually used at the work site.

2. Subject to the provisions of paragraph 3, any claimant who has performed labor or furnished material in accordance with the Contract documents in the prosecution of the Work provided in the Contract, who has not been paid in full therefor before the expiration of ninety (90) days after the day on which such claimant performed the last of such labor or furnished the last of such materials for which he claims payment, may bring an action on this bond to recover any amount due him for such labor or material, and may prosecute such action to final judgment and have execution on the judgment. The Obligee need not be a party to such action and shall not be liable for the payment of any costs, fees or expenses of any such suit.

3. Any claimant who has a direct contractual relationship with any subcontractor of the Principal from whom the Principal has not required a subcontractor payment bond, but who has no contractual relationship, express or implied, with the Principal, may bring an action on this bond only if he has given written notice to the Principal within one hundred eighty (180) days from the day on which the claimant performed the last of the labor or furnished the last of the materials for which he claims payment, stating with substantial

accuracy the amount claimed and the name of the person for whom the Work was performed or to whom the material was furnished. Notice to the Principal shall be served by registered or certified mail, postage prepaid, in an envelope addressed to the Principal at any place where his office is regularly maintained for the transaction of business. Claims for sums withheld as retainages with respect to labor performed or materials furnished shall not be subject to the time limitations stated in this paragraph 3.

4. No suit or action shall be commenced hereunder by any claimant.

   a. Unless brought within one year after the day on which the person bringing such action last performed labor or last furnished or supplied materials, it being understood, however, that if any limitation embodied in this bond is prohibited by any law controlling the construction hereof, the limitation embodied within this bond shall be deemed to be amended so as to be equal to the minimum period of limitation permitted by such law.

   b. Other than in a Virginia court of competent jurisdiction, with venue as provided by statute, or in the United States District Court for the district in which the project, or any part thereof is situated.

5. The amount of this bond shall be reduced by and to the extent of any payment or payments made in good faith hereunder.

Signed and sealed this _____ day of _____

_____
Contractor / Principal **(SEAL)**

_____ By:_____
Witness Typed Name: _____
Title: _____

_____
Surety **(SEAL)**

By:_____
Attorney-in-Fact
Typed Name: _____

AFFIDAVIT AND ACKNOWLEDGEMENT OF ATTORNEY-IN-FACT

COMMONWEALTH OF VIRGINIA
(or alternatively, Commonwealth or State of _____)

CITY of _____

I, the undersigned notary public, do certify that _____, whose name is signed to the foregoing labor and material payment bond in the sum of _____ and dated _____ and which names the Commonwealth of Virginia, _____, as Obligee, personally appeared before me today in the above jurisdiction and made oath that he/she is the attorney-in-fact of _____, a _____ corporation which is the Surety in the foregoing bond, that he/she is duly authorized to execute on the above Surety's behalf the foregoing bond pursuant to the Power of Attorney noted above and attached hereto, and on behalf of the surety, he/she acknowledged the foregoing bond before me as the above Surety's act and deed

She/he has further certified that her/his Power of Attorney has not been revoked.
[Complete if Power is recorded: Clerk's Office: _____;
Deed Book/Page No. or Instrument No.: _____.]

Given under my hand this _____ day of _____.

_____
Notary Public (SEAL)

My name (printed) is _____

My commission expires: _____

APPROVED:

_____
Attorney General/Designee Date

DGS-30-092 (Rev. 07/05)

CONTRACT CHANGE ORDER
(Summary of Work)

CO-11 Part 1

Project Code	Change Order Number	Change Order Date
501 - 06501 - 005		#N/A

	Code	Description
Agency:	501	Virginia Department of Transportation
Project:	06501	New Kent Safety Rest Area & Information Center I-64W
Sub-Project:	005	0

To: 0

Gentlemen:

Under your contract dated January 0, 1900 for work at
New Kent County, Virginia
#
the Contract Price, in accordance with the Contract Documents, the sum of #N/A

#VALUE!

#

#

(Failure to include a change for time shall waive any change to the time allowed by the Contract for completion of the Work unless the parties mutually agree in writing to postpone a determination of the change to time resulting from the Change Order. Such determination may not be postponed more than 45 days from the approval of this Change Order by the agency.)

CONTRACT COST SUMMARY
(inclusive of this Change Order)

Original Contract Amount	$0.00
Cumulative Changes Orders	#N/A
Revised Contract Amount	#N/A

CONTRACT SCHEDULE SUMMARY
(inclusive of this Change Order)

Original Contract Completion Date:	January 0, 1900
Cumulative Schedule Extension:	#N/A
Revised Contract Completion Date:	#N/A

CHANGE AUTHORIZATION

Issued By: _____ _____
Authorized A/E Representative *Date*

Accepted By: _____ _____
Authorized Contractor Representative *Date*

Approved / Recommended By: _____ _____
Authorized Agency Representative *Date*

Prior approval by the Governor or his designee is required for each Change Order which causes an increase in the Contract Price if the resulting cumulative sum of all Change Orders exceeds **25% of the original Contract Amount** or **$50,000**, whichever is greater.

#N/A

Recommended By: _____ _____
Director, Division of Engineering and Buildings *Date*

Approved By: _____ _____
Director, Department of General Services *Date*

DGS-30-092 | **CONTRACT CHANGE ORDER** | **CO-11**

(Rev. 07/05) | **(Itemization of Work)** | **Part 2**

By" and "Reason for Change"

Project Code	**Change Order Number**	**Change Order Date**
501 - 06501 - 005	**0**	#N/A

#N/A **#N/A**

Change Order Total (sum of the details listed below) = $ -

#N/A

#N/A

Reference Number	Description	Initiated By	Reason Code	Amount

* - If an asterisk appears adjacent to an "Amount" entry, this indicates the "Initiated By" or "Reason for Change" field(s) have not been filled-in properly. Please enter the appropriate values in both of these fields.

DGS-30-096
(Rev. 07/05)

CHANGE ORDER JUSTIFICATION
(Architect / Engineer's Justification)

CO-11a
Part 1

Project Code	Change Order Number	Change Order Date
501 - 06501 - 005	**0**	#N/A

A/E's DESCRIPTION OF WORK INVOLVED

Click here to enter text.

A/E's EXPLANATION OF WHY WORK IS REQUIRED

Click here to enter text.

A/E's RECOMMENDATION

Architect / Engineer

Date

DGS-30-096
(Rev. 07/05)

CHANGE ORDER JUSTIFICATION
(Agency's Justification)

CO-11a
Part 2

Project Code	Change Order Number	Change Order Date
501 - 06501 - 005	**0**	#N/A

ADDITIONAL CONTINGENCY REQUIRED ?

Construction Contingency Amount Shown on Last Approved CO-8:	
Cumulative Amount Of All Change Orders To-Date, Inclusive Of This Change Order:	#N/A
#N/A	#N/A

Remarks:

COST SHARING FOR DESIGN ERRORS AND OMISSIONS

Is this change order required in whole, or in part, because of a design error of omission?

If "Yes", outline the proposed cost sharing, if any, by the responsible design professional:

ADDITIONAL SUPPORT FOR CHANGES IN AGENCY REQUIREMENTS

1) When was the change in requirements (function, mission) known?

2) If known before construction bidding, why were the needed changes excluded from the bid package?

3) What quantitative impact would the lack of this change have on the mission or service provided by the agency?

4) Why can the work not be packaged and bid separately?

By: _____ _____
Agency Representative Date

DGS-30-096
(Rev. 07/05)

CHANGE ORDER JUSTIFICATION
(Statistical Summary)

CO-11a
Part 3

Project Code	Change Order Number	Change Order Date
501 - 06501 - 005	**0**	#N/A

Reason Code		Amount		Reason Code Description
1	$		-	1 - Unforeseen site conditions
2	$		-	2 - Existing building or utility conditions not as shown
3	$		-	3 - Change in agency's requirements
4	$		-	4 - Substitution or alternate method
5	$		-	5 - Item not as shown or specified
6	$		-	6 - Conflict or discrepancy in requirements
7	$		-	7 - Other.
Total	**$**		**-**	

DGS-30-104
(Rev. 10/04)

SCHEDULE OF VALUES AND CERTIFICATE FOR PAYMENT NO. 1

CO-12
(P1)

PROJECT TITLE: New Kent Safety Rest Area & Information Center
PROJECT NUMBER: 501-06501-005
INSTITUTION/AGENCY: Virginia Department of Transportation
FOR PERIOD FROM:
FOR PERIOD TO:

Attach the following supporting detail sheets: - CO-12 (P2) sheets which list approved change orders. - CO-12 (P3) sheets which list original contract line items.	TOTAL VALUE	VALUE OF WORK COMPLETED			PERCENT COMPLETE
		PREVIOUS VALUE TO DATE	VALUE THIS REPORT	CURRENT VALUE TO DATE	
	A	B	C	D = B + C	E = D / A
ORIGINAL CONTRACT (sum of P3 sheets)	0.00	0.00	0.00	0.00	0%
APPROVED CHANGE ORDERS (sum of P2 sheets)	0.00	0.00	0.00	0.00	0%
ADJUSTED CONTRACT TOTAL	0.00	0.00	0.00	0.00	0%
RETAINAGE		0.00	0.00	0.00	
NET REQUISTION AMOUNT		0.00	**0.00**	0.00	

Amount This Certification

CONTRACTOR CERTIFICATION

The undersigned Contractor requests payment of that portion of the contract price shown on the last line of the foregoing Schedule of Values, and represents and warrants to the Owner that: (1) the data shown on the Schedule of Values is accurate and correct; (2) the Work covered by this Certificate has been completed in accordance with the Contract Documents; (3) all previous progress payments received from Owner on account of Work done under this Contract have been applied to discharge in full (except for allowable retainage) all obligations of Contractor incurred in connection with Work covered by prior Certificates for Payment (N/A for Payment No. 1) ; (4) title to all materials and equipment for which payment is requested in this Certificate, whether or not incorporated in said Work, will pass to Owner at time of payment free and clear of all liens, claims, security interests and encumbrances (except such materials and equipment which are covered by a Bond previously accepted by Owner).

FEIN #: 0 Contractor: 0

Date: By: _____

Type Name:

ARCHITECT/ENGINEER CERTIFICATION

This is to certify that, in accordance with the terms of a contract for Project Number 501-06501-005 executed the day of , by and between,
, the contractor, and the Commonwealth of Virginia,
Owner, for work at New Kent County, Virginia, there is due to the

Contractor the amount of $0.00

No Dollars and No Cents

A/E: DJG, Inc.

By: _____ Print Name: _____ Date: _____

AGENCY ACTION

Amount approved for payment this certificate is: _____

_____ Dollars (_____)

By: _____ Title: _____ Date: _____

By: _____ Title: _____ Date: _____

SCHEDULE OF VALUES AND CERTIFICATE FOR PAYMENT NO. 1

* * * APPROVED CHANGE ORDERS * * *

PROJECT TITLE: New Kent Safety Rest Area & Information Center
PROJECT NUMBER: 501-06501-005
For Period: January 00, 1900 to January 00, 1900

CHANGE ORDER NUMBER	CHANGE ORDER DESCRIPTION	TOTAL VALUE	VALUE OF WORK COMPLETED			PERCENT COMPLETE
			PREVIOUS VALUE TO DATE	VALUE THIS REPORT	CURRENT VALUE TO DATE	
		A	B	C = D - B	D = A x E	E
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%
Enter CO #	Enter description here	0.00	0.00	0.00	0.00	0%

DGS-30-104
(Rev. 10/04)

CO-12
(P3)

SCHEDULE OF VALUES AND CERTIFICATE FOR PAYMENT NO. 1

* * * ORIGINAL CONTRACT - ITEMIZED BREAKDOWN * * *

PROJECT TITLE: New Kent Safety Rest Area & Information Center
PROJECT NUMBER: 501-06501-005
FOR PERIOD: January 00, 1900 to January 00, 1900

Complete Column "F" below for all line items.

Complete Columns "G" thru "J" to identify those subcontractors or suppliers who are certified by the Department of Minority Business Enterprise (DMBE) as a disadvantaged vendor.

ITEM NO.	ITEM DESCRIPTION	TOTAL VALUE	VALUE OF WORK COMPLETED			PERCENT COMPLETE	VENDOR NAME	DMBE CERTIFICATE NUMBER	Firm Type		
			PREVIOUS VALUE TO DATE	VALUE THIS REPORT	CURRENT VALUE TO DATE				Small Business	Minority-Owned Business	Woman-Owned Business
	Column:	A	B	C = D - B	D = A x E	E	F	G	H	I	J
1	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
2	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
3	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
4	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
5	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
6	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
7	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
8	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
9	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
10	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
11	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
12	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
13	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
14	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
15	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
16	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
17	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
18	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
19	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
20	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
21	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
22	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
23	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
24	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
25	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
26	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
27	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
28	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N
29	Enter description here	0.00	0.00	0.00	0.00	0%			N	N	N

COMMONWEALTH OF VIRGINIA
AFFIDAVIT OF PAYMENT OF CLAIMS

By:

This day _____ personally appeared before me, _____, a Notary Public in and for the City (County) of _____, _____ and, being by me first duly sworn, states that all subcontractors and suppliers of labor and materials have been paid all sums due them for work performed or materials furnished in the performance of the Contract between the Commonwealth of Virginia, _____ _____, Owner, and_____ , Contractor, dated _____ ,20 ___ , for the construction of the New Kent Safety Rest Area & Information Center on I-64 West in New Kent County, Virginia, or arrangements have been made by the Contractor satisfactory to such subcontractors and suppliers with respect to payments of such sums as may be due them by the Contractor.

Typed Contractor Name

By:

Signature

Typed Name &Title of Person Signing

Subscribed and sworn to before me this _____ day of _____ , 20____. My commission expires on the _____ day of _____ , 20____ .

Notary Public

CERTIFICATE OF COMPLETION BY ARCHITECT/ENGINEER or PROJECT MANAGER

Date:

TO: Division of Engineering and Buildings
Department of General Services
805 East Broad Street
Richmond, Virginia 23219

PROJECT TITLE:	**NEW KENT SAFETY REST AREA & INFORMATION CENTER**
PROJECT NO:	**501-06501-005**
INSTITUTION/AGENCY:	**VIRGINIA DEPARTMENT OF TRANSPORTATION**
ADDRESS:	**1401 EAST BROAD ST. RICHMOND, VA 23219**

In accordance with the requirements of the Contract Between Owner and Architect / Engineer for Professional Services (Form CO-3) or the Contract Between Owner and Project Manager and based upon the knowledge gained in the performance of the services required in said Agreement, the undersigned hereby states that the above named project was fully completed in accordance with the requirements of the Contract Documents on _____.
(date)

All applicable tests, certificates and regulatory inspections required by the 2003 edition of the Virginia Uniform Statewide Building Code, which was the basis of the design of the project, have been performed and the Owner has been provided with a copy of each report. A copy of the Final Report of Structural & Special Inspections (Form CO-13.1b) is attached to this certificate. All deficiencies noted during the inspection have been corrected or resolved.

The handicapped standards required by Chapter 7 of the applicable A/E Manual, as revised, have been met.

The Owner has been provided with a copy of all warranties and guarantees, including the starting date(s) of all warranties and guarantees, written and unwritten, required by the Contract Documents.

By: DJG, Inc.

_____
Matthew G. Burton, AIA
Architecture Group Manager

Attachments:
Final Report of Structural & Special Inspections (Form CO-13.1b)

ARCHITECT/ENGINEER'S CERTIFICATE OF SUBSTANTIAL COMPLETION

TO: Division of Engineering and Buildings Date:
Department of General Services
805 East Broad Street
Richmond, Virginia 23219

PROJECT TITLE: **NEW KENT SAFETY REST AREA & INFORMATION CENTER**
PROJECT NO: **501-06501-005**
INSTITUTION/AGENCY: **VIRGINIA DEPARTMENT OF TRANSPORTATION**
ADDRESS: **1401 EAST BROAD ST. RICHMOND, VA 23219**

In accordance with the requirements of the Agreement between the Owner and the Architect / Engineer and based upon the knowledge gained in the performance of the architectural / engineering services provided in said Agreement and the reports of the Owner's Inspection and Testing entities, the undersigned Architect / Engineer states that the following portions of the project named above are substantially complete in accordance with the requirements of the Contract Documents and are recommended for occupancy: *(Indicate portions which are recommended for occupancy)*

All applicable tests, certificates and regulatory inspections required by the _____ edition of the Virginia Uniform Statewide Building Code, which was the basis of the design of the project, have been performed with respect to the substantially completed portions of the project and the Owner has been provided with a copy of each report, except for the following: _____

The handicapped standards required by Chapter 7 of the applicable A/E Manual, as revised, have been met. A copy of the Final Report of Structural & Special Inspections, Form CO-13.1b, is attached to this certificate.

A tentative list of unfinished Work and defective Work, referred to as the "punch list", is attached hereto. This list may not be all-inclusive, and the failure to include an item in it does not alter the responsibility of CONTRACTOR to complete all the Work in accordance with the Contract Documents. The items in the tentative list shall be completed or corrected by CONTRACTOR within _____ days of the above date of Substantial Completion.

By: DJG, Inc.

_____
Matthew G. Burton, AIA
Architecture Group Manager

The following documents are attached to and made a part of this Certificate:
- Final Report of Structural & Special Inspections (Form CO-13.1b)
- Checklist for Beneficial Occupancy (Form CO-13.3b)
- Punch list containing page 1 through _____

FINAL REPORT OF STRUCTURAL & SPECIAL INSPECTIONS

INSTITUTION/AGENCY: **VIRGINIA DEPARTMENT OF TRANSPORTATION**

PROJECT TITLE: **NEW KENT SAFETY REST AREA & INFORMATION CENTER**

PROJECT NO: **501-06501-005**

ARCHITECT/ENGINEER OF RECORD: **DJG, INC.**

To the best of my information, knowledge, and belief, the Structural & Special Inspections required for this project, and itemized in the Form CO-6b, Special Inspections listing attached to the Form CO-6a, Statement of Structural and Special Inspections, submitted for permit, have been completed.

The discrepancies that remain outstanding since the last interim report dated_____, have been corrected or have been resolved as follows:

(Attach 8-1/2 x 11 continuation sheet(s) if required to complete the description of corrections or resolution of deviations)

Respectfully submitted,

Structural Engineer

Signature Date

Type or print name

Project Inspector

Signature Date

Type or print name

Agency Project Manager

Signature Date

Type or print name

CERTIFICATE OF COMPLETION BY CONTRACTOR

Date:

Division of Engineering and Buildings
Department of General Services
805 East Broad Street
Richmond, Virginia 23219

PROJECT TITLE:	**NEW KENT SAFETY REST AREA & INFORMATION CENTER**
PROJECT NO:	**501-06501-005**
INSTITUTION/AGENCY:	**VIRGINIA DEPARTMENT OF TRANSPORTATION**
ADDRESS:	**1401 EAST BROAD ST. RICHMOND, VA 23219**

In accordance with the requirements of the Contract Between Owner and Contractor (Form CO-9), the undersigned Contractor hereby states that the above named project has been fully completed in accordance with the requirements of the Contract Documents as modified by approved change orders.

All applicable tests, certificates and regulatory inspections required by the Virginia Uniform Statewide Building Code and the Contract Documents have been performed with respect to the completed project and the Owner has been provided with a copy of each report.

As-built marked up prints of the completed project have been provided to the Architect/Engineer as required by the Contract Documents.

The Owner has been provided with a copy of all warranties and guarantees, including the starting date(s) of all warranties and guarantees, written and unwritten, required by the Contract Documents.

All training, operating instructions and maintenance manuals required by the Contract Documents have been provided to the Owner.

(Typed Contractor Name)

By:

(Typed Name &Title of Person Signing)

cc: Agency
A/E

CERTIFICATE OF PARTIAL OR SUBSTANTIAL COMPLETION BY CONTRACTOR

Date:

Division of Engineering and Buildings
Department of General Services
805 East Broad Street
Richmond, Virginia 23219

PROJECT TITLE: **NEW KENT SAFETY REST AREA & INFORMATION CENTER**
PROJECT NO: **501-06501-005**
INSTITUTION/AGENCY: **VIRGINIA DEPARTMENT OF TRANSPORTATION**
ADDRESS: **1401 EAST BROAD ST. RICHMOND, VA 23219**

In accordance with the requirements of the Agreement between the Owner and the Contractor, the undersigned Contractor hereby states that portions of the above named project are substantially completed in accordance with the requirements of the Contract Documents as modified by approved change orders. Those portions of the project now substantially complete are: *(list or describe)*

All applicable tests, certificates and regulatory inspections required by the Virginia Uniform Statewide Building Code and the Contract Documents have been performed with respect to the substantially completed portions of the project and the Owner has been provided with a copy of each report.

As-built marked up prints of the substantially completed portions of the project have been provided to the Architect/Engineer as required by the Contract Documents.

The Owner has been provided with a copy of all warranties and guarantees, including the starting date(s) of all warranties and guarantees, written and unwritten, required by the Contract Documents with respect to the completed portions of the project, except as follows:

All training, operating instructions and maintenance manuals required by the Contract Documents have been provided to the Owner, except as follows: *(list or describe)*

This certificate does not constitute an acceptance of Work not in accordance with the Contract Documents nor is it a release of CONTRACTOR's obligation to complete the Work in accordance with the Contract Documents.

Typed Contractor Name

By:

Typed Name &Title

DGS-30-364
(Rev. 02/01)

SUBMITTAL REGISTER FOR:									PROJECT CODE #						(Reference General Conditions Section 24)
			TYPE OF SUBMITTAL												
REF NO.	SPECIFICATION SECTION NUMBER	DESCRIPTION	SHOP DRAWING	SAMPLE	MFR'S DATA	CERTIFICATE	TEST REPORT	GUARANTEE		DATE RECEIVED	DATE SENT TO AE	DATE NEEDED BY	DATE RETURNED FROM AE	ACTION ON SUBMITTAL		REMARKS
999	999999	Example Description	X	X	X	X	X	X	X	12/31/99	12/31/99	12/31/99	12/31/99	12/31/99	12/31/99	Example remarks

DGS-30-160 **CO-14a**
(Rev. 03/05)

OPINION OF A/E PERFORMANCE (BID / CONSTRUCTION PHASE)

A/E Firm: **Date:**

Constultants:
Civil:
Structural:
Mechanical:
Plumbing:
Electrical:

New Construction: ☐
Renovation: ☐
Gross Area: SF

Agency:
Project Title:
Project Location:
Project Code #:

A/E Estimate:
Award Amt:
Changes:
Final Amt:

Rate only those items for which you have knowledge of the A/E's (and/or their consultant's) performance
Rate as follows:

ABOVE AVERAGE (Work appears to be above minimum standards.)
AVERAGE (Work appears to meet required minimum standards.)
BELOW AVERAGE (Work appears to be below minimum standards.)
N/A (Not applicable.)

Note: Support "ABOVE AVERAGE" and "BELOW AVERAGE" ratings with additional comments.
Use the next page or attach separate sheets.

BID/CONSTRUCTION PHASE ITEMS	EVALUATION BY AGENCY PROJ. MGR.	EVALUATION BY PROJECT INSPECTOR
Plan Accuracy and Coordination	Average	Average
Adequacy of Details	Average	Average
Specification Adequacy	Average	Average
Shop Drawing Review Time	Average	Average
Cooperation with Owner	Average	Average
Cooperation with Contractor	Average	Average
Site Visit Adequacy	Average	Average
Responsiveness to Jobsite Issues	Average	Average
Responsiveness to Requests for Clarification/Information	Average	Average
Change Orders	Average	Average
Substantial Completion	Average	Average
Final Inspection	Average	Average
Record Drawings	Average	Average
Maintenance/Operations Manuals	Average	Average
Project Closeout	Average	Average
OVERALL RATING	Average	Average

DGS-30-160 **CO-14a**
(Rev. 03/05)

OPINION OF A/E PERFORMANCE (BID/CONSTRUCTION PHASE)

A/E Firm: 0

Comments supporting ABOVE AVERAGE or BELOW AVERAGE ratings:

DGS-30-164 **CO-14b**
(Rev. 03/05)

OPINION OF CONTRACTOR PERFORMANCE

Contractor: **Date:**

Subcontractors:
Mechanical:
Electrical:

New Construction: ☐
Renovation: ☐

Agency:
Project Title:
Project Location:
Project Code #:

Gross Area: SF
Award Amt:
Changes:
Final Amt:

Rate only those items for which you have knowledge of the Contractor's (and/or their subcontractors') performance. Rate as follows:

ABOVE AVERAGE (Work appears to be above minimum standards.)
AVERAGE (Work appears to meet required minimum standards.)
BELOW AVERAGE (Work appears to be below minimum standards.)
N/A (Not applicable.)

Note: Support "ABOVE AVERAGE" and "BELOW AVERAGE" ratings with additional comments. Use the next page or attach separate sheets.

CONSTRUCTION ITEMS	EVALUATION BY AGENCY PROJ. MGR.	EVALUATION BY PROJECT INSPECTOR	EVALUATION BY PROJECT ARCH / ENGR
GC Management of Project	Average	Average	Average
Conformance to Schedule	Average	Average	Average
Superintendence/Supervision	Average	Average	Average
Coordination of Work of Trades	Average	Average	Average
Scheduling of Work by Trades	Average	Average	Average
Conformance with Plans and Specifications	Average	Average	Average
Shop Drawing Reviews by General Contractor	Average	Average	Average
Erosion Control Compliance	Average	Average	Average
As-Built Drawings	Average	Average	Average
Cooperation with Inspectors	Average	Average	Average
Cooperation with Owner & AE	Average	Average	Average
Change Order Documentation	Average	Average	Average
Requests for Information	Average	Average	Average
Job Site Appearance/Cleanup	Average	Average	Average
Job Site Safety	Average	Average	Average
Substantial Completion	Average	Average	Average
Final Completion	Average	Average	Average
Punch List	Average	Average	Average
Operations Manuals and Training	Average	Average	Average
Mechanical Systems Operation	Average	Average	Average
Electrical Systems Operation	Average	Average	Average
OVERALL RATING	Average	Average	Average

DGS-30-164 **CO-14b**
(Rev. 03/05)

OPINION OF CONTRACTOR PERFORMANCE

Contractor: 0

Comments supporting ABOVE AVERAGE or BELOW AVERAGE ratings:

CONSTRUCTION RISK ALLOCATION

GENERAL

The Owner desires to have this construction project completed and open to the Public on or before June 9, 2007. In that light, the Owner is instituting, as a part of this contract a Construction Risk Allocation Program which intends to assist in achieving or improving the completion date of June 9, 2007.

The participation in the Risk Allocation Program is a mandatory program for the general Contractor, Subcontractors, the Design Professionals as well as the Owner.

The Risk Allocation Program consists of assignment and acceptance of the responsibility for Construction Project Risk to the identified responsible parties. Prior to the commencement of the contract, a Dispute Resolution System will be installed prior to beginning any work, for the purpose of expeditious resolution of issues which arise during construction.

PRE-BID MEETING

The Owner and Design Professional will hold a PRE-BID MEETING to discuss the elements of this Risk Allocation Program. The attendees should include:

- The Owner
- The Design Professional
- All General Contractor bidding on the project.
- All Subcontractors with expected Subcontracts in excess of $100,000.

At the PRE-BID MEETING the Risk Allocation Program will be discussed with all attendees. Questions will be fielded by the Owner and/ or Design Professionals so that all attendees have a thorough understanding of the Risk Allocation Program prior to preparation of the Bids for the project.

The Agenda for this meeting will include, but not be limited to,

1. Thorough discussion of the project expectations and schedule.
2. Discussion of Dispute Resolution System, which will be in place during construction.
3. Discussion of the Communication System, which will be implemented during the construction process.
4. Discussion of Incentive and Disincentive clause.
5. Discussion of Allocation of Specific Risk.

Allocation of Specific Risk

Risk	***Responsible Party***		
	Owner	Design Professional	Contractor
1. Site Access	X		
2. Environmental Clean-Up	X		
3. Subsurface Conditions	X		
4. Construction Document Deficiencies		X	
5. Performance Standards		X	
6. Constructability of Design		X	
7. Means & Methods			X
8. Construction Quality			X
9. Labor Productivity			X
10. Weather, Acts of God	X (Delay Risk)		X (Dollar Risk)
11. Changes in Law	X		
12. Construction Schedule			X
13. Adequate Financing & Payment	X		
14. Unresolved Disputes	X	X	X

EARLY COMPLETION INCENTIVE
AND
RELEASE OF ALL CLAIMS
CERTIFICATION
FORM

For, and in consideration of the agreed settlement sum of THREE HUNDRED THOUSAND DOLLARS AND NO CENTS ($300,000.00) the sufficiency of which is hereby acknowledged _____(the Undersigned Contractor) for itself and on behalf of its agents, employees, subcontractors, and material suppliers or any combination thereof, and its or their respective heirs, executors, administrators, successors, and assigns hereby accepts said agreed settlement sum in full and final settlement for early completion of the Contract _(name and contract identification #) awarded _(date)_, VDOT Project # _____ on _(date of early completion)_ in strict accordance with all Contract requirements, and does hereby release, acquit and forever discharge the Commonwealth of Virginia , its political subdivisions, departments, agencies and instrumentalities, the Comptroller of Virginia, the Commissioner of the Virginia Department of Transportation, directly and indirectly and in their official capacities, and their respective heirs, executors, administrators, successors and assigns, of and from any and all actions, causes of actions, liability, rights, suits, contracts, claims and demands whatsoever, in law or in equity, for injuries, damages, costs, expenses, attorney fees, consultant fees, or any other thing whatsoever, whether known or unknown except as was set forth in the Contract.

Further, in consideration of the above agreed upon final settlement sum, the Undersigned expressly declares and agrees: 1) that all claims, actions, liabilities, etc. as described above past, present or that may be discovered in the future are disputed and this final settlement and release of all claims shall not, and shall never be treated or considered as evidence of liability, nor as an admission of liability or responsibility at any time or in any manner whatsoever; and 2) that those hereby released will not be estopped from or otherwise barred from asserting, and they expressly reserve the right to assert, any claim or cause of action, known or unknown, they may have against the Undersigned or any others, whether now or in the future provided this document will not enlarge or modify any obligations of _____ (the Undersigned Contractor), and 3) the payment of the agreed upon settlement sum is subject to (i) reduction by the amount of any outstanding debts owed to the Virginia Department of Transportation on this project and (ii) set off by the Commonwealth of Virginia pursuant to the Virginia Debt Collection Act (Virginia Code Section 2.1-726, *et seq.*) and its implementing policies, procedures and regulations, provided however, the foregoing release will not extend to the Undersigned's right to contest the validity of such reduction or set-off but will be final in all other respects.

The Undersigned acknowledges under the above terms that this Release of all Claims has been fully and carefully reviewed and that all the terms and provisions contained herein are understood and agreeable.

I/we am/are authorized to execute this Early Completion Incentive and Release of All Claims Certification form on behalf of _____ (the Undersigned Contractor) this ____ day of _____, 2007.

Executed By: _____

Title: _____

State of _____
City\County of _____, To Wit

I, the undersigned, a Notary Public in and for the City\County and State aforesaid, do hereby certify that _ _____, whose name is signed to the foregoing instrument, bearing date of the _____ day of _____ , 2007 has this day acknowledged the same before me in my City\County and State aforesaid on behalf of _(the aforementioned Contractor)_.

Given under my hand this _____ day of _____ , 2007.

_____
Notary Public

My commission expires _____

S107F1B-0105

VIRGINIA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION FOR
STORM WATER POLLUTION PREVENTION PLAN

June 2, 2004

INTRODUCTION

The Storm Water Pollution Prevention (SWPP) Plan, also referred to as the Erosion and Sediment Control (ESC) Plan, Storm Water Management (SWM) Plan and related Road and Bridge Specifications and Standards contained within all contract documents, are required for all land-disturbing activity of 10,000 square feet or greater (2,500 square feet or greater in Tidewater Virginia).

In addition, if the land-disturbing activity is 1 acre or greater, a VSMP Construction Permit is required. The requirements of this permit are satisfied by the Contractor's compliance with the SWPP Plan terms and conditions.

The Contractor and/or Subcontractor shall be responsible for reading, understanding, and complying with the terms and conditions of the SWPP Plan as follows (where identified below, Subcontractor(s) shall comply with this special provision as their duties include ESC/SWM related contract items):

I. PROJECT IMPLEMENTATION RESPONSIBILITIES

The Contractor and/or Subcontractor is responsible for the installation, maintenance, inspection, and ensuring the functionality of all erosion and sediment control measures on a daily basis and all other stormwater and pollutant runoff control measures identified within the plans, specifications, permits, and contract documents.

The Contractor and/or Subcontractor shall take all reasonable steps to minimize or prevent any stormwater or non-stormwater discharge, which has a reasonable likelihood of adversely affecting human health, public and/or private properties.

II. CERTIFICATION REQUIREMENTS

In addition to satisfying the personnel certification requirements contained within 107.14(a), the Contractor and Subcontractor shall each certify their activities by adequately completing, signing, and submitting Form C-45 VDOT SWPP Plan Contractor and Subcontractor Certification Statement to the Engineer prior to commencing any project related land-disturbing activities, both on-site and off-site.

III. OFF SITE REQUIREMENTS

The Contractor and/or Subcontractor shall develop erosion and sediment control plan(s) and stormwater management plan(s) for submission and acceptance by the Engineer prior to usage of any support facilities, off-site borrow and disposal areas, construction materials or equipment storage areas, and other industrial storm water discharge directly related to the construction process. Such plans, upon acceptance, will become a part of and subject to the overall project plan, VSMP Construction Permit, and contract requirements.

IV. REPORTING PROCEDURES

A. Inspection Requirements

The Contractor and/or Subcontractor are responsible for conducting inspections in accordance with the requirements of Section 107.14(a). The Contractor and/or Subcontractor shall document

such inspections by completion of form C-107 (a) and (b) (Construction Runoff Control Inspection Form and Continuation Sheet) in strict accordance with directions contained within the form.

B. Unauthorized Discharge Requirements

The Contractor and/or Subcontractor shall not discharge into state waters sewage, industrial wastes, other wastes or any noxious or deleterious substances or otherwise alter the physical, chemical, or biological properties of state waters and make them detrimental to the public health, animal or aquatic life, the use of such waters for domestic or industrial consumption, for recreation or for other uses.

1. Notification of discharges or noncompliance

The Contractor and/or Subcontractor shall quickly notify the Engineer upon the discovery of or potential of any unauthorized, unusual, extraordinary, or non-compliant discharge from the construction activity, but in any case not later than 24 hours after said discovery.

2. Detailed report requirements for discharges or noncompliance

The Contractor and/or Subcontractor shall submit to the Engineer within 5 days of the discovery of the discharge a written report describing details of the discharge to include its volume, location, cause, and any apparent or potential effects on private and/or public properties or endangerment to public health, as well as steps being taken to eliminate the discharge. A completed form C-107 (a) and (b) shall be used for such reports.

C. Plans, Changes, and Deficiencies

1. Contractor SWPP Plans

The Contractor shall provide SWPP Plans that document the location and description of potential pollutant sources such as vehicle fueling, storage of fertilizers or chemicals, sanitary waste facilities, construction and waste materials etc. prior to any such pollutant sources being brought onto the project site. Such documentation shall include a description of the controls to reduce, prevent and control pollutants from these sources including spill prevention and response. The Contractor shall submit such documentation in accordance with Section 107.14(b)1 to the Engineer and, thereby, immediately becoming a component of the project SWPP Plan and subject to all corresponding requirements contained therein.

The Contractor shall ensure that plans are kept onsite at all times in accordance with Section 105.06.

2. Changes and Deficiencies

The Contractor and/or Subcontractor shall report to the Engineer when any planned physical alterations or additions are made to the construction activity or deficiencies in the project plans or contract documents are discovered that could significantly change the nature or increase the quantity of the storm water pollutants discharged from the construction activity.

VDOT
Stormwater Pollution Prevention (SWPP) Plan
Contractor and Subcontractor Certification Statement

Order No.: _____ Project Number: _____

Route: _____ Contract ID. #: _____

I certify under penalty of law that I understand the terms and conditions of the project contract, plans, permits, specifications and standards related to erosion and sediment control and stormwater management requirements as approved by the Virginia Department of Conservation and Recreation and the general Virginia Stormwater Management Program (VSMP) Construction Permit (if applicable to this project) issued by the Virginia Department of Environmental Quality that authorizes the storm water discharges associated with industrial activity from the construction site identified as part of this certification as described in the bid document and off-site support activities.

Signature: _____

Name: _____

Title: _____

Contracting Firm: _____

Address: _____

Phone Number: _____

Address/Description of Site: _____
(Include off-site areas)

_____

Certified on this date: _____

(Note: This form must be returned with performance and payment bonds)

Completed forms must be maintained on active project sites at ALL times.

CONSTRUCTION RUNOFF CONTROL INSPECTION FORM

VDOT Road & Bridge Specification 107.14(a)

Clear Form

Project Name/ID: _____ 24-hr Rainfall (in.): ____

Contractor: _____ Time: _____

Type of Inspection: *After Rainfall* ☐ *During Rainfall* ☐ *Weekly* ☐ *Other* ☐

Item #	Inspection Questions	N/A[1]	YES[2]	NO [3]
1.	Have all denuded areas requiring temporary or permanent stabilization been stabilized?	☐	☐	☐
2.	Have disposal/borrow and soil stockpiles (on-site and off-site) been stabilized with seeding and/or protected with sediment trapping measures? Do off-site areas have VDOT approved ESC plans?	☐	☐	☐
3.	Does permanent vegetation provide adequate stabilization for completed project areas?	☐	☐	☐
4.a.	Have perimeter controls been constructed as a first step in land disturbing activities (includes clearing OR grubbing)?	☐	☐	☐
4.b.	Are perimeter and other erosion and sediment control structures and systems being maintained, inspected and repaired to ensure functionality (4VAC 50-30-60 also)?	☐	☐	☐
5.	Have earthen structures, such as dams, dikes, and diversions, been immediately stabilized?	☐	☐	☐
6.	Have sediment basins and traps been constructed according to plans, specifications, and/or standards?	☐	☐	☐
7.	Are finished cut and fill slopes adequately stabilized?	☐	☐	☐
8.	Is concentrated water flowing through adequate slope drains, flumes, or non-erodible channels on cut or fill slopes?	☐	☐	☐
9.	Do slope faces have drainage or protection from water seeps?	☐	☐	☐
10.	Do all operational storm sewer and culvert inlets have inlet protection in accordance with plans, specifications, and/or standards?	☐	☐	☐
11.	Are stormwater conveyance channels stabilized with channel lining and/or outlet protection?	☐	☐	☐
12.	Is in-stream construction conducted using measures to minimize channel damage?	☐	☐	☐
13.	Are temporary stream crossings of non-erodible material installed where construction equipment crosses?	☐	☐	☐
14.a.	Are all VDOT water quality permit requirements being adhered to?	☐	☐	☐
14.b.	Are material/equipment handling/storage areas clean and free of spills, leaks, or other deleterious materials and are related protective measures adequate? If there is an SPCC Plan for this project, is it being adhered to?	☐	☐	☐
15.	Is re-stabilization of in-stream construction complete before leaving the area?	☐	☐	☐
16.a.	Are utility trenches stabilized properly according to the specifications?	☐	☐	☐
16.b.	Is effluent from dewatering operations being filtered (including in-stream structure dewatering)?	☐	☐	☐
17.	Are construction entrances adequately protected, being maintained and public roadways kept clean from soil and mud?	☐	☐	☐
18.	Have all temporary control structures that are no longer needed been removed and such areas been stabilized?	☐	☐	☐
19.a.	Are properties and waterways adjacent to development adequately protected from pollutant discharge, erosion, flooding, and sedimentation? Has encroachment outside of the project limits been prevented?	☐	☐	☐
20.	Are dust control measures being implemented?	☐	☐	☐
21.	Have all deficiencies from previous reports been addressed?	☐	☐	☐

1 – N/A: not applicable; **2**-YES: All items related contract requirements, plans, specifications, standards, and permits pertaining to this question are being satisfied

3 *- In accordance with the terms of the Contract and/or permit(s), the Contractor above, shall correct all noted deficiencies as indicated by "NO" boxes checked above and any other documented deficiencies attached to this form (see continuation sheets) by the following corrective action date:*			_____ ***Corrective Action Date***
This report was written by a VDOT ESCCC in accordance with specification 107.14 (a).:	_____ *Print Name of Contractor ESCCC*	_____ *Contractor ESCCC Signature*	_____ *Date*
This report is accepted and confirmed by a VDOT Project Inspector as designated by the Resident Engineer:	_____ *Print Name of Project Inspector*	_____ *Signature*	_____ *Date*

Copy 1 – Contractor | *Copy 2 – VDOT Project Inspector* | *Copy 3 – Project Engineer/Manager/File*

Completed forms must be maintained on active project sites at ALL times.

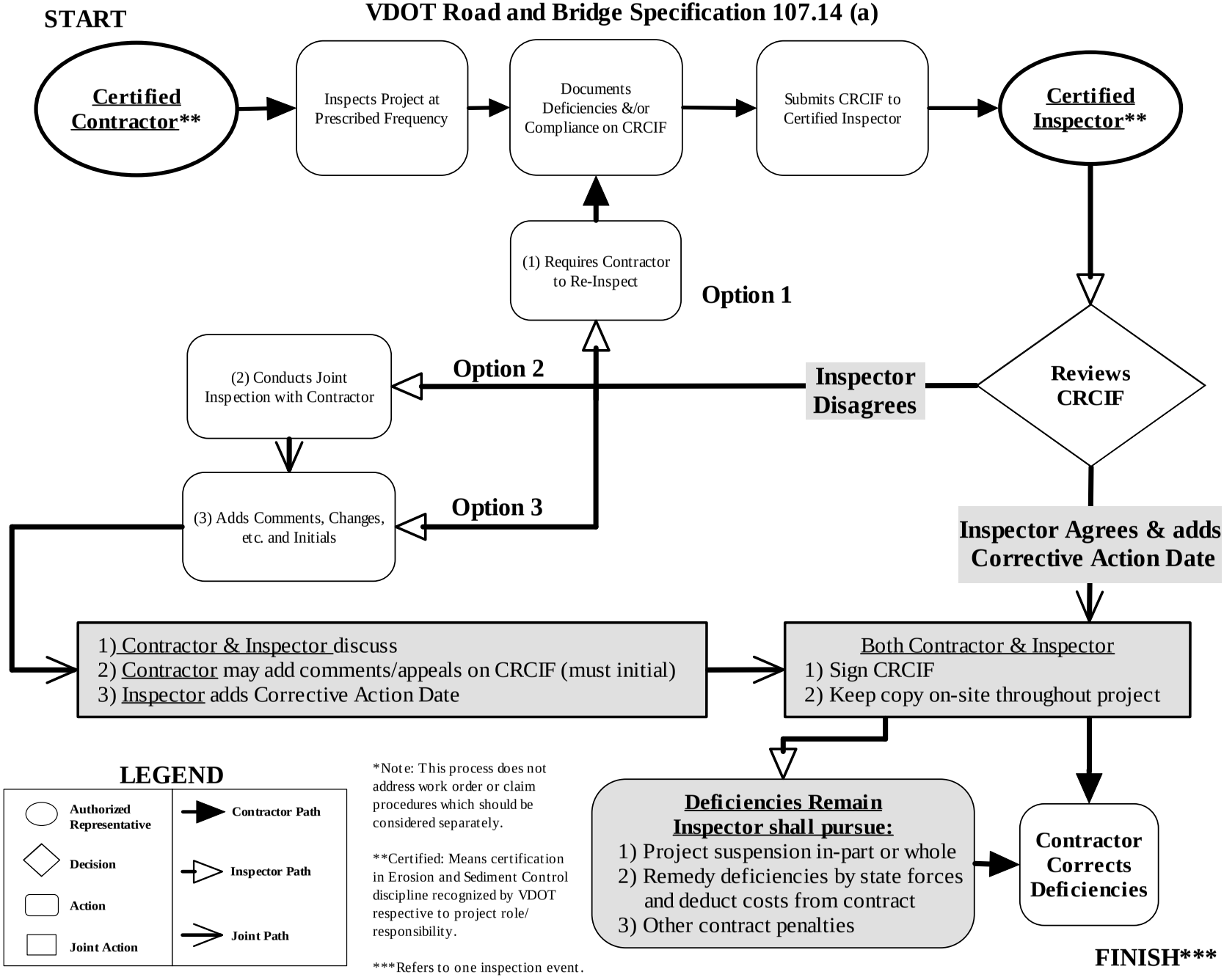
CONSTRUCTION RUNOFF CONTROL INSPECTION FORM

VDOT Road & Bridge Specification 107.14(a)
Continuation Sheet

Project Name/ID: _____ Date: _____

Item # (See sheet 1)	Station	Description of problem, location, and corrective action [3] (see back)	To be corrected by (date):

CONSTRUCTION RUNOFF CONTROL INSPECTION FORM (CRCIF)
Chain of Documented Communication*
VDOT Road and Bridge Specification 107.14 (a)



*Note: This process does not address work order or claim procedures which should be considered separately.

**Certified: Means certification in Erosion and Sediment Control discipline recognized by VDOT respective to project role/ responsibility.

***Refers to one inspection event.

Note (1-2): Non-compliant, non-compliance, or deficient is defined as documented evidence of 1) off-site damage in the form of sedimentation, unauthorized dewatering or pollutant discharge, erosion, flooding, encroachment outside of the project/permit limits, or a permit condition deficiency, 2) on-site damage in the form of significant erosion, flooding, or sedimentation, or 3) a repeat deficiency of related specifications.

Note (3): The table below provides a brief correlation of Virginia's Erosion and Sediment Control Regulations (VESCR) to VDOT's Road and Bridge (R&B) Specifications and Standards. This table is not all - inclusive and is not intended to be the only means for determining whether or not a deficiency of a specification exists for the project identified in this inspection. This table may be utilized as a quick reference for identifying potential contract deficiencies related to applicable stormwater and water quality related environmental laws, regulations, and permits during VDOT construction and maintenance activities. Refer to the project contract, the approved site specific plan, VDOT Road and Bridge Specifications, VDOT Road and Bridge Standards, and any applicable environmental permit conditions obtained for the project referenced in this report for the detailed information needed to ensure compliance with all environmental laws and regulations. Please see guidance manual for details on regulations, permit conditions, VDOT R&B Specifications and VDOT R&B Standards.

Virginia Erosion and Sediment Control (ESC) Regulations 4VAC 50-30-40		**Virginia Department of Transportation Approved Specifications and Standards**		
MS	*General Title of Minimum Standard (MS)*	**Road and Bridge Specification Title**	***Refer to appropriate Spec year***	***Refer to appropriate Std. year***
			Spec. #	**Standard #**
1	Permanent or Temporary Soil Stabilization	Incremental Seeding Seeding, Mulch	303.03(b) 603, 244	Roadside Development Sheet
2	Soil Stockpiles and Borrow Areas	Borrow, Disposal Topsoil Stockpiles	106.03, 106.04, 303.04(a)	Numerous, site & plan specific
3	Permanent Vegetation	Incremental Seed Seeding, Sodding, Planting Soil Ret. Coverings	303.03(b) 603, 604, 605 606	Roadside Development Sheet
4	First Step Control Measures	Erosion and Siltation Control	303.03	114.06, 114.10
5	Earthen Structure Stabilization	Temp Diversion Incremental Seed	302.04 303.03(b)	113.01, 114.10. 114.02, 114.03
6	Sediment Traps and Basins	Sediment Basin	303.03(f)	114.08, 116.04
7	Cut and Fill Slopes	Earth Berms & slope drains Incremental Seed Removal of Unsutable Material, etc. Stabilization of Slopes	303.03(a) 303.03(b) 303.04(e-h)	 114.04
8	Concentrated Runoff on Slopes	Earth Berms & Slope Drains	303.03(a)	115.02
9	Water Seeps From Slope	Riprap Underdrains	414 501	115.01
10	Inlet Protection	Erosion and Siltation Control Temporary Silt Fence & Barriers Drop Inlet Silt Trap	107.14(a) 303.03(e)	 114.06 114.07
11	Stormwater Conveyance Channels & Outlet Protection	Temp. Diversion Channel Lining Riprap Check Dams Outlet Protection	302.04 414	113.01, 114.02, 114.03 115.01 114.05 114.01
12	Work in Live Watercourse	Water Permits, Erosion and Siltation Control, Structure Excavation Dismantling & Removing, Riprap	107.14(b)1, 303.03, 401 413, 414	Numerous, site & plan specific
13	Temporary Stream Crossing	Water Permits	107.14(b)1	Numerous, site & plan specific
14	Live Water Course Permits and Laws	Laws to be observed: Water Quality Permits, Certificates, Licenses	107.01 107.02(abc)	Numerous, site & plan specific
15	Water Course Bed and Bank Stabilization	Legal Relations, Water Permits Incremental Seeding Seeding, Sodding, Planting, Soil Retention Coverings, Gabions	107 303.03(b) 603, 604, 605, 606, 610	Numerous, site & plan specific
16	Underground Utility Construction	Protecting Water Supplies Dewatering Basin	520.03a&b	 114.09
17	Temporary Construction Entrances	Erosion and Siltation, Opening to Traffic	107.14(a), 107.15, 512.03	115.01
18	Temporary Control Removal	Erosion and Siltation Control - 4th Paragraph	303.03	
19	Stormwater: Downstream Protection	Laws to be observed: Water Permits	107, 107.01, 107.14(b). 1.	Numerous, site & plan specific
		Air Pollution, Dust Control	107.14(b) 2., 511, 239	
4VAC 50-30-60		Maintenance & Inspection Requirements	107	

Note (3) continued: Provide as much detail as possible. If a deficiency of a contract specification or plan item is noted, the description must contain 1) the VDOT specification #, 2) permit condition deficiency (if applicable), 3) description of the deficiency, 4) a corrective action deadline – should be a reasonable time frame to correct the deficiency unless damages may be exacerbated if not addressed immediately, and 5) recommended solution or approach. If this is a follow-up inspection, previously addressed deficiencies that have been corrected must be documented as such. This section of the inspection form should also be utilized to note positive items such as exceeding the performance expectations or time frames set by a specification. If conformity to specifications and plans is being achieved but site conditions indicate that plan or specification adjustments may be needed to address environmental concerns, such conditions should be immediately referred to the Resident Engineer and Hydraulics Engineer for plan modifications.

SMALL, WOMEN-OWNED AND MINORITY-OWNED (SWAM) BUSINESSES

POLICY STATEMENT

The Virginia Department of Transportation is committed to fostering the utilization of Small, Women and Minority Businesses (SWAM) in all its procurement activities. Accordingly, offerors shall make good-faith efforts to ensure that SWAMs have the maximum practicable opportunity to compete for subcontract work in connection with this project. For this project, the Department has not established a numerical SWAM-participation goal.

While the Department has established no numerical SWAM participation goals for this project, the offeror is encouraged to faithfully consider SWAMs for all subcontracting opportunities pursuant to the Department's policy.

CONTRACTOR'S OBLIGATION

During the term of the contract/purchase order, the contractor shall continue to make good faith efforts to ensure that SWAMs committed to in the Bid/Proposal have maximum opportunity to successfully perform in the contract. These efforts shall include but not be limited to the following:

- Negotiating in good faith to attempt to finalize and execute a subcontract agreement with the SWAMs committed to in the Bid/Proposal/Proposal
- To seek out and utilize SWAM suppliers and SWAM subcontractors
- Continuing to provide assistance to SWAM subcontractors or suppliers in obtaining bonding, lines of credit, etc., if required by the contractor.
- Notifying a SWAM in writing of any potential problem and attempting to resolve the problem prior to formally substituting the SWAM subcontractor.
- As with all subcontractors, timely payment of all monies due and owing to SWAM subcontractors and suppliers.
- Timely submittal of complete and accurate SWAM monthly report.

Contract Compliance Reporting Requirements -- The contractor shall submit monthly progress reports to the Department, in conformance with the currently approved schedule, reflecting its SWAM participation. **The CO-12, Schedule of Values and Certificate for Payment (Form DGS-30-104, latest revision) shall be submitted monthly to comply with this reporting requirement.**

Change in Contract Amount -- The dollar amount of change orders, or any other contract modifications that increase or decrease the work area in which SWAM's participation has been committed to in the Bid/Proposal, shall be commensurately added to, or subtracted from, the total contract base figure used to compute actual dollars paid to SWAMs. Revised total contract dollar values shall be reflected in the monthly progress report submitted to the Department.

GOOD FAITH EFFORTS

The Department encourages Bidders/Proposers to use the following Good Faith Efforts:

- When applicable attend pre-proposal (pre-bid) meeting(s) scheduled by the Department to inform prospective competitors and SWAM's of contracting and subcontracting opportunities;

- Advertise in at least one newspaper of general circulation, at least one trade association publication, **and** at least two minority-focused media. The advertisements shall be placed in the business, classified or request for sub-bid section. The initial advertisement shall appear in these publications no later than twenty calendar days prior to the originally specified bid opening date. A list of minority focus newspapers may be obtained from the Department's Civil Rights Division.

- Select portions of the work for which interest from SWAMs was solicited in a manner to increase the likelihood of achieving SWAM participation. When economically feasible, divide work into small tasks or quantities to permit maximum participation of SWAM businesses.

- Consider in-house capabilities and try to subcontract out various functions or components which the Bidder/Proposer could otherwise do or furnish itself. Good faith effort constitutes comparing prices from SWAMs to those of other non-SWAMs in the same trade or industry, and not solely to those of the Bidder.

- Extend written invitations to bid to at least (1) SWAM no later than 20 calendar days prior to the Department's originally specified bid due date.

- Outreached to SWAMs through the minority and women contractor, trade and professional associations at least 20 calendar days prior to the specified bid opening date.

- Assisted SWAMs, who requested assistance in obtaining lines of credit or bonding, if bonding is required.

- Provided adequate information about plans, specifications, and/or contracting.

- Negotiated in good faith with interested, capable and competitive SWAMs, not rejecting SWAMs as unqualified without sound reasons.

SWAM PROGRAM DEFINITIONS

Minority-Owned Business Enterprise: A business concern which is at least 51 percent owned by one or more minorities or in the case of a corporation, partnership or limited liability company or other entity, at least 51 percent of the equity ownership interest in which is owned by one or more minorities and whose management and daily business operations are controlled by one or more of such individuals.

Minority Individual: "Minority" means a person who is a citizen of the United States or a legal resident alien and who satisfies one or more of the following definitions:

"Asian Americans" means all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian subcontinent, or the Pacific Islands, including but not limited to Japan, China, Vietnam, Samoa, Laos, Cambodia, Taiwan, Northern Marinas, the Philippines, U. S. territory of the Pacific, India, Pakistan, Bangladesh and Srilanka and who are regarded as such by the community of which these persons claim to be a part.

"African Americans" means all persons having origins in any of the original peoples of Africa and who are regarded as such by the community of which these persons claim to be a part.

“Hispanic Americans" means all persons having origins in any of the Spanish speaking peoples of Mexico, South or Central America, or the Caribbean Islands or other Spanish or Portuguese cultures and who are regarded as such by the community of which these persons claim to be a part.

"Native Americans" means all persons having origins in any of the original peoples of North America and who are regarded as such by the community of which these persons claim to be a part or who are recognized by a tribal organization.

"Eskimos and Aleuts" means all persons having origins in any of the peoples of Northern Canada, Greenland, Alaska, and Eastern Siberia and who are regarded as such in the community of which these persons claim to be a part.

Small Business Enterprise: "Small business enterprise" shall mean an independently owned and operated business which, together with affiliates, has 250 or fewer employees, or average annual gross receipts of $10 million or less averaged over the previous three years. Nothing in this provision prevents a program, agency, institution or subdivision from complying with the qualification criteria of a specific state program or a federal guideline to be in compliance with a federal grant or program.

Woman-Owned Business Enterprise: A business concern which is at least 51 percent owned by one or more women who are U.S. citizens or legal resident aliens, or in the case of a corporation, partnership or limited liability company or other entity, at least 51 percent of the equity ownership interest in which is owned by one or more women, and whose management and daily business operations are controlled by one or more of such individuals.

Disadvantaged Business Enterprise: A small business concern which is at least 51 percent owned by one or more socially and economically disadvantaged individuals, or, in the case of any corporation, partnership or limited liability company or other entity, at least 51 percent of the equity ownership interest in which is owned by one or more socially and economically disadvantaged individuals and whose management and daily business operations are controlled by one or more of the socially and economically disadvantaged individuals who own it.

SWAM CERTIFICATION

SWAM firms need not be certified as of the Bid/Proposal date, but must be certified prior to contract award.

A current SWAM list may be obtained on-line at *www.DMBE.state.va.us*

Or by contacting DMBE at:

Department of Minority Business Enterprises

200-202 9th street, 11th floor

Richmond, Va. 23219

(804) 786-6585

Application for certification by DMBE may be obtained by submitting Uniform Certification Application. This form is attached hereto.

If the Bidder/Proposer is a SWAM, the firm should have current SWAM status with the DMBE.

All SWAM certifications must be final by the due date of the Bid/Proposal in order to counted for SWAM participation.

SWAM GOALS

Overall SWAM Goals:
Due to the data collection challenges VDOT has chosen to use the statewide SWAM goals of 40%. The 40% SWAM goal equals 20% small business, 10 Women owned Business, and 10% minority owned businesses.

Utilization of Race and Gender Goals:
These aspirational goals will be addressed by requiring good faith efforts, and analyzing lager contracts to determine if debundling is warranted to attain the goals. The goals listed below are annual goals, not rigidly set project goals. Each year the goals will be adjusted accordingly and will be based on the utilization of M/WBEs by business category by race and gender neutral means, gradually reducing the race and/or gender conscious goal and increasing the race and gender neutral goal. Our goal is to replace it completely with race and gender neutral options.

As a means to address the disparity identified in the VDOT Disparity Study and In accordance with Section 2.2-4343 A.19 of the Code of Virginia and Executive Order 29, the follow chart outlines the race-based goals for 2005:

Race-Based Goals	
M/WBE Classification	**Race/Gender Goal %**
Construction Prime	
African American	.70
Hispanic American	0
Asian American	.17
Native American	.24
Nonminority Women	2.00
Construction Subcontracting	
African American	2.01
Hispanic American	.31
Asian American	.27
Native American	.41
Nonminority Women	6.26
Architecture and Engineering Prime	
African American	1.57
Hispanic American	1.57
Asian American	0
Native American	0
Nonminority Women	3.27
Architecture and Engineering Subcontracting	
African American	1.37
Hispanic American	1.43
Asian American	1.42
Native American	0
Nonminority Women	9.44

Other Services – Prime Contracts	
African American	8.52
Hispanic American	2.51
Asian American	4.30
Nonminority Women	21.72
Goods and Supplies	
African American	4.23
Hispanic American	1.51
Asian American	5.08
Nonminority Women	17.33

SECTION 00870

DESIGN SELECTION SUMMARY

PART 1 GENERAL

1.1 DESIGN BASIS PRODUCT REFERENCE

The finish materials, patterns, and colors indicated in this section meet the performance requirements of the specifications and shall be used as a reference for aesthetic properties required for the installation. Alternate products that provide an aesthetic match to the products listed herein and also meet the performance requirements in the individual technical sections will be allowed.

1.2 EXTERIOR FINISH COLOR SELECTIONS

a. Field Brick (BR - 1): Match Artisan moulded brick "Mohican" modular

b. Brick Headers (BR - 2): Match Watsontown Brick Co. - Sanded smooth brick "Sturbridge" modular

c. Brick Arches (BR - 3): Match Artisan moulded brick "Jefferson" modular

d. Pre-cast Concrete: Off-White, Machine Honed Finish

e. Roof : Synthetic Slate per Section 07310
Color: Midnight Gray

f. Roof Penetrations: Paint to match roof slates

g. Spandrel Glass: Black

h. Mortar: Match Flamingo Brixment "C73"

i. Exterior trim including windows, doors, casings, and eave trim -
Color: Match Benjamin Moore 2148-40

j. Gutters and Downspouts: Natural Copper

1.3 GENERAL INTERIOR COLORS / FINISH NOTES

a. Lavatory Systems: Solid Surfacing.
Color: To be selected from Manufacturer's standard palette.

b. Toilet partitions: Solid Phenolic Core. Color to be selected from Manufacturer's standard palette.

c. Telephone Enclosures: INTERIOR: 26" W x 16" D x 40" H, Stainless Steel with acoustic stainless steel solid dividers. EXTERIOR: similar to above, WITH CLOSED TOP.

d. Benches: Keystone Ridge, "Dragonfly" DF15, DuMor, Bench 106, FairWeather, "Pacifica" PA-1. COLOR: GLOSS BLACK

PART 2 PRODUCTS

The Contractor shall provide finish materials and colors as follows:

Material	Manufacturer	Color	Remarks
Concrete Stain			
ST-1	Per Section 09900	Azure Blue	(Office and corridor)
Epoxy Flooring			
EPX-1	Per Section 09670	Fine Matioc, primary dove gray with white and Steel Blue flecks.	(Toilets)
Glazed Block			
GC-1		Steel Blue	Wainscot and coved base in toilet, 4x8 score
GC-2		Off-White	Walls above 3'-4" in toilet, 4x4 score
Grout		Off-White	
Polished Face Architectural Block			
POL-1	Per Section 04200	Match Clayton Polished block	(Lobby and Vending)
Paint			
P-1	Per Section 09900	Benjamin Moore	(Window & door trim)
P-2	Per Section 09900	Benjamin Moore	(Doors in corridor)
P-3	Per Section 09900	Benjamin Moore	(Doors in toilets)
P-4	Per Section 09900	Benjamin Moore	(Signage & wall base)
P-5	Per Section 09900	Benjamin Moore	(Ceilings)
Plastic Laminate			
PLAM-1	Per Section 06410	Light Walnut Wood Grain Pattern	

Material	Manufacturer	Color	Remarks
Solid Surface Countertop			
SS-1	Per Section 06650	Charcoal Gray with Mirrored Flecks	Satin finish
Terrazzo			
TZO-1	Per Section 09445	"Snow White" Epoxy Resin Composition: 50% Recycled Clear Glass - Size 0 50% Recycled Clear Glass - Size 1	
TZO-2	Per Section 09445	"Pewter" Epoxy Resin Composition: 10% Recycled Mirror Glass - Size 1 45% Recycled Tinted Glass, Gray - CAG - Size 0 45% Recycled Tinted Glass, Gray - CAG - Size 1	
TZO-3	Per Section 09445	"Charcoal" Epoxy Resin Composition: 50% Recycled Tinted Glass Gray - CAG - Size 0 50% Recycled Tinted Glass, Gray - CAG - Size 1	
Rubber Base			
RB-1	4" Top set rubber cove base: Armstrong, Flexco, or Johnsonite		Dark Gray, selected from Manufacturer's standard palette

PART 3 EXECUTION

All preparation, installation, cleaning and maintenance requirements are listed in the individual specification sections.

-- End of Section --

SECTION 01039
COORDINATION AND MEETINGS

PART 1 GENERAL

1.1 COORDINATION

a. Coordinate scheduling, submittals, and Work of the various sections of the Project Manual to assure efficient and orderly sequence of installation of interdependent construction elements.

b. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

c. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

d. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

e. Coordinate completion and clean up of Work of separate sections in preparation for Substantial Completion.

1.1.1 FIELD ENGINEERING

a. Employ a Land Surveyor registered in the State of Virginia.

b. Contractor to locate and protect survey control and reference points.

c. LEED Project ManagmentControl datum for survey is that shown on Drawings.

d. Verify set-backs and easements, confirm drawing dimensions and elevations.

e. Provide field survey engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.

1.2 PRECONSTRUCTION MEETING

a. Owner will schedule a meeting after Notice of Award.

b. Attendance Required: Owner, Architect, General Contractor, and Key Sub Contractor.

c. Agenda:

1. Submission of complete list of Subcontractors, list of Products, schedule of values, and construction schedule.
2. Designation of personnel representing the Contractor, Owner, and the Architect.
3. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures. LEED Project Management.
4. Scheduling.

1.3 PROGRESS MEETINGS

a. The Contractor shall schedule and administer meetings throughout progress of the work at weekly intervals.

b. The Contractor will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings, and record and distribute minutes.

c. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Architect, and as requested and appropriate to agenda topics for each meeting.

d. Agenda:

1. Review of submittals schedule and status of submittals.
2. Review of proposed changes to the work schedule.
3. Maintenance of progress schedule and as-built drawings.
4. Corrective measures to regain projected schedules.
5. Planned progress during succeeding work period.
6. Coordination of projected progress.
7. Maintenance of quality and work standards.
8. Review minutes of previous meetings.
9. Review of work progress.
10. Field observations, problems, and decisions.
11. Identification of problems which impede planned progress.
12. Review of off-site fabrication and delivery schedules.
13. Leed Update
14. Other business relating to Work.

e. The Contractor will record minutes and distribute copies after meeting to participants.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

-- End of Section --

SECTION 01110

SUMMARY OF WORK

PART 1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

1.1.1 Project Description

The project includes demolition and reconstruction of the New Kent Safety Rest Area & Information Center, I-64 West. Work includes site and landscape design for the new building location, exterior plaza and site amenities, and new stormwater management system. New buildings include a 9058gsf rest area building and a 316gsf maintenance building. Scope of work includes architectural, civil, structural, mechanical, electrical, and landscape work required to provide a complete, fully finished and operable rest area facility. A LEED silver certificaton is required for the project.

1.1.2 Location

The project site is located on Interstate 64 westbound at mile marker 213 in New Kent County, Virginia. The nearest interchanges are at mile markers 211 and 214. The site is directly accessible by Interstate and also partially accessible from Criss Cross Road in New Kent County

1.2 EXISTING WORK

In addition to "FAR 52.236-9, Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements":

a. Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain.

b. Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as approved by the Owner. At the completion of operations, existing work to remail in a condition equal to or better than that which existed before new work started.

1.3 LOCATION OF UNDERGROUND FACILITIES

Obtain digging authorization prior to start of excavation by contacting the Owner 5 calendar days in advance. Scan the construction site with Ground Penetrating Radar and electromagnetic or sonic equipment, and mark the surface of the ground or paved surface where existing underground utilities are discovered. Verify the elevations of existing piping, utilities,and any type of underground or encased obstruction not indicated to be specified or removed but indicated or discovered during scanning in locations to be traversed by piping, ducts, and other work to be conducted or installed. Verify elevations before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made.

1.3.1 Notification Prior to Excavation

Notify the Owner at least 5 days prior to starting excavation work.

Contact Miss Utility 48 hours prior to excavating. Contractor is responsible for marking all utilities not marked by Miss Utility.

1.4 OWNER-FURNISHED MATERIAL AND EQUIPMENT

The Owner will furnish equipment noted on the plans as "O.F.C.I." (Owner-Furnished, Contractor Installed) for installation by the Contractor:

1.4.1 Delivery Schedule

Notify the Owner in writing at least 30 calendar days in advance of the date on which the materials and equipment are required.

1.4.2 Delivery Location

The materials and equipment will be delivered to the jobsite.

1.5 OWNER-INSTALLED WORK

The owner will furnish and install equipment items noted as "O.F.O.I." (Owner-furnished, Owner-Installed).

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01150

LEED GREEN BUILDING SUMMARY, REQUIREMENTS AND GOALS

PART 1 GENERAL

1.1 SUMMARY

A. This project is designed to achieve all Prerequisites and no less than 26 points under the US Green Building Council's LEED Green Building Rating System for New Construction and Major Renovations version 2.2 with all current revisions, for at least a LEED Certified-level Rating.

1. Other LEED prerequisites and credits needed to obtain LEED certification are dependent on material selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests.

2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification are dependent on the Architect's design and other aspects of the Project that are not part of the Work of the Contract.

B. Refer to Appendix D for the LEED Checklist for LEED Prerequisites and Credits being pursued for this project.

C. The General Contractor and Subcontractors are responsible for all requirements of the LEED Green Building Rating System that are contained throughout these Specifications and indicated on the drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Division 1 Section "Indoor Air Quality Management" for detailed LEED requirements to be incorporated into the construction process.

B. Division 1 Section "Construction Waste Management" for detailed LEED requirements to be incorporated into the construction process.

C. Division 1 Section "Commissioning" for detailed commissioning requirements.

D. Division 1 through 16 Sections for LEED requirements specific to Work of each of those Sections. These requirements may or may not include references to LEED.

1.3 REFERENCES, LEED-RELATED

A. Advanced Buildings BenchmarkTM Version 1.1, New Buildings Institute

B. ASHRAE Advanced Energy Design Guide for Small Office Buildings 2004

C. ASHRAE Standard 52.2-1999: Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size

D. ASHRAE Standard 55- 2004: Thermal Environmental Conditions for Human Occupancy

E. ASHRAE Standard 62.1-2004: Ventilation for Acceptable Indoor Air Quality

F. ASHRAE/IESNA Standard 90.1-2004 - Energy Standard for Buildings Except Low-Rise Residential Buildings

G. ASTM C1371-04 - Standard Test method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers

H. ASTM C1549-04 - Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer

I. ASTM E408-71(1996)e1 - Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques

J. ASTM E903-96 - Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres

K. ASTM E1918-97 - Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field

L. ASTM E1980-01 - Standard Practice for Calculating Solar Reflectance index of Horizontal and Low-Sloped Opaque Surfaces

M. Carbon Trust Good Practice Guide 237 - Natural ventilation in non-domestic buildings - a guide for designers; developers and owners

N. Carpet and Rug Institute (CRI) "Green Label" IAQ Testing Program for Carpet Cushion

O. Carpet and Rug Institute (CRI) "Green Label Plus" IAQ Testing Program for Carpet

P. Chartered Institution of Building Services Engineers (CIBSE) Applications Manual 10: 2005, Natural ventilation in non-domestic buildings

Q. Energy Policy Act 1992

R. EPA "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," PB90200288

S. EPA Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters

T. EPA Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices (Chapter 3)

U. Forest Stewardship Council Guidelines

V. Green Seal (GC) Standard GC-03 "Anti-Corrosive Paints"

W. Green Seal (GS) Standard GS-11 "Paints"

X. Green Seal (GS) Standard GS-36 "Commercial Adhesives"

Y. IESNA Recommended Practice 33-1999: Lighting for Exterior Environments.

Z. International Performance Measurement and Verification Protocol, Option

AA. International Standard ISO 14021-1999 - Environmental Labels and Declarations - Self-Decalred Environmental Claims (Type II Environmental Labeling)

BB. Sheet Metal and Air Conditioning-General Contractors National Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction, Chapter 3 "Control Measures".

CC. South Coast Air Quality Management District (SCAQMD) Rule #1113: "Architectural Coatings," including most recent amendments

DD. South Coast Air Quality Management District (SCAQMD) Rule #1168: "Adhesive and Sealant Applications", including most recent amendments.

EE. USDOE Commercial Buildings Energy Consumption Survey Database

FF. USGBC (US Green Building Council) LEED (Leadership in Energy and Environmental Design) Green Building Rating System:

1. LEED for New Construction and Major Renovations, Version 2.2, with all current revisions.

1.4 DEFINITIONS, LEED-RELATED:

A. ALBEDO (a.k.a. solar reflectance): The ratio of the reflected electromagnetic energy to the incoming electromagnetic energy.

B. CHAIN-OF-CUSTODY: Tracking procedure to document the status of a wood product from the forest to the ultimate consumer and is used to verify compliance with FSC guidelines.

C. CONSTRUCTION WASTE: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

D. EMISSIVITY (a.k.a. infrared emittance): A parameter between 0 and 1 that indicates the ability of a material to shed infrared radiation.

E. LOCALLY/ REGIONALLY MANUFACTURED (for LEED Materials Credit 5): Refers to the final assembly of components into the building product that is furnished and installed by the tradespeople. For example, if the hardware comes from Seoul, South Korea, the lumber from Vancouver, British Columbia, and the joist is assembled in Kent Washington, then the location of the final assembly is Kent, Washington.

F. LOCALLY/ REGIONALLY EXTRACTED, HARVESTED, OR RECOVERED (for LEED Materials Credit 5.2): Refers to the location where the material was extracted, harvested or recovered. For products containing multiple materials, each material must be calculated separately.

G. NON-TOXIC: Neither immediately poisonous to humans, nor poisonous after a long period of exposure.

H. POST-CONSUMER RECYCLED CONTENT: Consumer waste that has become a raw material (feedstock) for another product. It originates from products that have served a useful purpose in the consumer market. Much of this feedstock comes from residential and commercial (office) recycling programs for aluminum, glass, plastic and paper. Other post-consumer feedstock is

supplied by businesses that recycle construction and demolition debris.

I. POST-INDUSTRIAL RECYCLED CONTENT: Output from a process that has not been used as part of a consumer product, that is sold, traded, or exchanged under commercial terms (including auditable transactions between profit centers within an organization) as feedstock for another industrial process, and that would otherwise be landfilled, incinerated or somehow disposed of as a waste, as defined by the Federal Trade Commission. For instance, a composite board manufacturer may purchase (or haul away for free) sawdust from a lumber mill or waste straw from a wheat farm. Wood chips would not fit this definition.

J. POTABLE WATER: Water that is suitable for drinking and is supplied from wells or municipal water systems.

K. RAPIDLY RENEWABLE: Materials made from agricultural products that are typically harvested within a ten-year or shorter cycle. Rapidly renewable materials include products made from bamboo, cotton, flax, jute, straw, sunflower seed hulls, wheatgrass, or wool.

L. RECYCLING: The collection, reprocessing, marketing and use of materials that were recovered or diverted from the solid waste stream.

M. SALVAGE: Contractor shall dismantle existing materials or assemblies carefully, provide protection suitable for maintaining existing conditions of materials, and store salvaged material for re-installation or other use as directed by Owner.

N. SEDIMENT: Soil and other debris that has been eroded and transported by storm or production run-off water.

O. SOLAR REFLECTANCE INDEX: The measure of a material's ability to reject solar heat, as shown by a small temperature rise. It is calculated according to ASTM E1980 using the material's Emittance and Reflectivity values. Standard black has an SRI of 0 and standard white has an SRI 0f 100.

P. SUSTAINABLE FORESTRY: The practice of managing forest resources to meet the long-term product needs of humans while maintaining the biodiversity of forested landscapes. The primary goal is to restore, enhance, and sustain a full range of forest values, both economic and ecological.

Q. TOXIC: Poisonous to humans, either immediately, or after a long period of exposure.

R. TRASH: Products or materials unable to be reused, returned, recycled, or salvaged.

S. VENTILATION: The process of supplying and removing air to and from interior spaces by natural or mechanical means.

T. VOLATILE ORGANIC COMPOUNDS (VOC): Carbon compounds that participate in atmospheric photochemical reactions, (excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides and carbonates, and ammonium carbonate). The compounds vaporize (become a gas) at normal room temperatures.

U. WASTE: Extra material or material that has reached end of its useful

life in its intended use.

1.5 SUBMITTALS, LEED MATERIALS COMPLIANCE

A. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.

B. LEED Action Plans: Provide preliminary submittals within 30 [thirty] days of the date established for commencement of the work indicating how the following requirements will be met.

1. Credit MR 2.1 and 2.2: Waste management plan complying with Division 1 Section "Construction Waste Management."

2. Credit MR 3.1: List of proposed salvaged and refurbished materials.

a. Identify each material that will be salvaged or refurbished, its source, and its cost.

b. Provide a preliminary spreadsheet, using USGBC's LEED-Online Project Management Tool LEED 2.2 Letter Template, verifying that the credit requirements will be met based on the identified salvaged and refurbished materials.

3. Credit MR 4.1[and 4.2]: List of proposed materials with recycled content.

a. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.

b. Provide a preliminary spreadsheet, using USGBC's LEED-Online Project Management Tool LEED 2.2 Letter Template, verifying that the credit requirements will be met based on the identified materials containing recycled content.

4. Credit MR 5.1 and 5.2: List of proposed regionally manufactured materials and regionally extracted, harvested, or recovered materials.

a. Identify each regionally manufactured material, its source, and cost.

b. Identify each regionally extracted, harvested or recovered material, its source, and cost.

c. Provide a preliminary spreadsheet, using USGBC's LEED-Online Project Management Tool LEED 2.2 Letter Template, verifying that the credit requirements will be met based on the identified regionally manufactured and regionally extracted, harvested, or recovered materials.

5. Credit MR 7.0: List of proposed certified wood products.

a. Provide a preliminary spreadsheet, using USGBC's LEED-Online Project Management Tool LEED 2.2 Letter Template, verifying that the credit requirements will be met based on the identified

certified wood products.

6. Credit EQ 3.1: Construction indoor air quality management plan complying with Division 1 Section "Indoor Air Quality Management".

C. Green material data: For each product submitted, exclusive of mechanical and electrical equipment, provide the following certifications by the manufacturer:

1. Information on salvaged/ refurbished materials, if applicable.

2. Location of product manufacture and the location of harvest/ extraction/ recovery of its primary raw materials.

3. Designation of the percentages of post-consumer and post-industrial recycled-content materials.

4. Information on rapidly renewable materials, if applicable.

5. FSC-certification of sustainably harvested wood materials, if applicable.

D. Low-Emitting Materials: Provide the following manufacturer information:

1. Product data or Material Safety Data Sheets (MSDS) highlighting volatile organic compound (VOC) content and hazardous components for each field-applied adhesive, sealant, paint and coating material used in the building interior.

2. Carpet and Rug Institute (CRI) "Green Label Plus" IAQ Testing Program compliance for carpet.

3. Carpet and Rug Institute (CRI) "Green Label" IAQ Testing Program compliance for carpet cushion.

4. Certification that composite wood and agrifiber boards used on the building interior are free of urea-formaldehyde binding resin.

5. Certification that laminating adhesives used to fabricate on-site and shop-applied composite wood assemblies are free of urea-formaldehyde binding resin.

E. On a monthly basis, with each application for payment, submit reports comparing actual purchasing and construction activities with LEED Action Plans. Provide updated LEED Material Compliance PDF's, in electronic and printed form, using the USGBC's LEED-Online Project Management Tool LEED 2.2 Letter Template for the following LEED Credits being sought for this Project:

1. Construction Waste Management (LEED Materials Credit 2): Use "LEED Letter Template" Worksheet "MRc2".

2. Recycled Content Materials (LEED Materials Credit 4): Use "LEED Letter Template" Worksheet "MRc4 ".

3. Regional Materials (LEED Materials Credit 5): Use "LEED Letter Template" Worksheet "MRc5".

4. Certified Wood Materials (LEED Materials Credit 7): Use "LEED

Letter Template" Worksheet "MRc7".

F. LEED Product Submittals Checklist: For each product submittal containing product data pertaining to LEED Requirements, provide the following completed checklist on the submittal cover sheet: "The materials submitted herein contain information pertaining to the following LEED requirements (check all that apply):

_____ Regionally Manufactured: Location _____

_____ Regionally Extracted/ Harvested/ Recovered Materials: Location_

_____ Recycled-Content Materials:
%Post-Consumer _____ %Post-Industrial _____

_____ Rapidly Renewable Materials.

_____ Certified Wood Materials.

_____ Low-Emission Materials.

_____ Energy-Efficient Products.

_____ Water-Efficient Products.

_____ High-Albedo Materials and _____ High-Emissivity Materials.

_____ Other (explain)_____."

1.6 PROJECT MEETINGS

A. Status of LEED green building-related work shall be discussed at the following meetings:

1. Work-initiation conference

2. Pre-installation conferences

3. Progress meetings

4. Coordination meetings

5. Owner's meetings

1.7 LEED GREEN BUILDING COORINATOR

A. The General Contractor shall designate their LEED(Green) Building coordinator at the start of the project. This coordinator will keep track of all contractor's LEED related activities and keep a LEED log for review by the projects LEED accredited professional.

PART 2 PRODUCTS

2.1 SALVAGED, REFURBISHED AND REUSED MATERIALS

A. Maximize use of salvaged, refurbished and reused materials where indicated in and subject to compliance with other requirements of project specifications

B. Provide minimum 10% of building materials that are salvaged, refurbished or reused, as calculated by material cost per LEED guidelines. Labor, installation equipment, mechanical, electrical and plumbing components, and specialty items such as elevators and equipment shall be excluded from this calculation. Furniture may be included, providing it is consistently included in Materials and Resources Credits 3-7.

2.2 RECYCLED-CONTENT MATERIALS

A. Maximize recycled-content of materials where indicated in and subject to compliance with other requirements of project specifications.

B. Provide materials with recycled content such that the sum of post-consumer recycled content plus one-half of the post-industrial content constitutes at least 10% of the total value of the materials in the project, in compliance with LEED Materials Credit 4, Parts 1 and 2.

C. Calculate recycled-content material cost per LEED guidelines, excluding labor, installation equipment, mechanical, electrical and plumbing components and specialty items such as elevators. Furniture may be included provided it is consistently included in Materials and Resources Credits 3-7.

2.3 REGIONAL MATERIALS

A. Maximize use of products manufactured and of primary materials extracted/ harvested/ recovered within a 500-mile radius of the project site where indicated in and subject to compliance with other requirements of the project Specifications.

B. Refer to map in APPENDIX C indicating 500 mile radius around New Kent County, VA for guidance.

C. Provide materials meeting the following requirements and document using the LEED Letter Template as described above:

1. Regionally Manufactured Materials: Provide minimum 20% of building materials, as calculated by material cost per LEED guidelines, excluding labor, installation equipment, mechanical and electrical components, that are extracted, processed and manufactured regionally within a 500-mile radius of the project site.

a. Where specifications state that products shall be manufactured regionally within a 500-mile radius of the project site, these products are required to be counted toward the minimum total materials required to meet LEED Materials Credit 5, Part 1.

b. Where specifications state that a preference shall be given to products manufactured regionally within a 500-mile radius of the project site, these products may, at the General Contractor's option, be counted toward the minimum total materials required to meet LEED Materials Credit 5, Part 1.

2.4 RAPIDLY RENEWABLE MATERIALS

A. Maximize use of rapidly renewable materials (materials replenishing themselves within a 10-year harvest cycle) where indicated in and subject to compliance with other requirements of project specifications.

B. Subject to selection of certain Alternates, provide rapidly renewable materials constituting at least 2.5% of the total value of the materials in the project, in compliance with LEED Materials Credit 6.

C. Calculate rapidly renewable material cost per LEED guidelines, excluding labor, installation equipment, mechanical, electrical and plumbing components and specialty items such as elevators. Furniture may be included provided it is consistently included in Materials and Resources Credits 3-7.

2.5 CERTIFIED WOOD MATERIALS

A. Maximize use of wood-based materials certified as sustainably harvested in accordance with the Forest Stewardship Council (FSC) guidelines where indicated in and subject to compliance with other requirements of the project Specifications.

B. Wood-based materials include but are not limited to the following materials when made from made wood, engineered wood products, or wood-based panel products:

1. Carpentry.

2. Structural glued-laminated timber.

3. Architectural woodwork.

4. Wood flooring.

5. Wood cabinets.

6. All other materials permanently installed in the project.

C. Calculate by material cost per LEED guidelines, excluding labor and installation equipment. Furniture may be included, provided it is included consistently in Materials and Resources Credits 3-7.

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01300

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Submittal

Shop drawings, product data, samples, and administrative submittals presented for review and approval.

1.1.2 Types of Submittals

All submittals are classified as indicated in paragraph "Submittal Descriptions (SD)". Submittals also are grouped as follows:

a. Shop drawings: As used in this section, drawings, schedules, diagrams, and other data prepared specifically for this contract, by contractor or through contractor by way of subcontractor, manufacturer, supplier, distributor, or other lower tier contractor, to illustrate portion of work.

b. Product data: Preprinted material such as illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature, catalog data, and other data to illustrate portion of work, but not prepared exclusively for this contract.

c. Samples: Physical examples of products, materials, equipment, assemblies, or workmanship that are physically identical to portion of work, illustrating portion of work or establishing standards for evaluating appearance of finished work or both.

d. Administrative submittals: Data presented for reviews and approval to ensure that administrative requirements of project are adequately met but not to ensure directly that work is in accordance with design concept and in compliance with contract documents.

1.1.3 Submittal Descriptions (SD)

SD-01 Preconstruction Submittals

Certificates of insurance
Surety bonds
List of proposed subcontractors
List of proposed products
Construction Progress Schedule
Submittal schedule
Schedule of values
Health and safety plan
Work plan
Quality control plan
Environmental protection plan
Construction Waste Management Plan

Construction Indoor Air Quality Managment Plan
LEED Action Plans as required by Division 1 Section 01150 "LEED Summary, Requirements and Goals".

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the contractor for integrating the product or system into the project.

Drawings prepared by or for the contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

Physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work.

SD-05 Design Data

Calculations, mix designs, analyses or other data pertaining to a part of work.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.)

Report which includes findings of a test required to be performed by the contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Investigation reports

Daily checklists

Final acceptance test and operational test procedure

SD-07 Certificates

Statements signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a supplier, installer or subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and Material Safety Data sheets concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

Factory test reports.

SD-10 Operation and Maintenance Data

Data intended to be incorporated in operations and maintenance manuals and inventory condition assessment database.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

As-built drawings

Special warranties

Posted operating instructions

Training plan

1.1.4 Approving Authority

Person authorized to approve submittal.

1.1.5 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce construction and materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.2 SUBMITTALS

Submit the following in accordance with the requirements of this section.

SD-11 Closeout Submittals

Submittal register

1.3 USE OF SUBMITTAL REGISTER

Prepare and maintain submittal register as the work progresses.

1.3.1 Submittal Register

Submit submittal register. Submit with quality control plan and project schedule required by Section 01400, "Quality Control". Verify that all submittals required for project are listed and add missing submittals. Complete the following on the register:

Activity Number: Activity number from the project schedule.

Contractor Submit Date: Scheduled date for Architect to receive submittals.

Contractor Approval Date: Date contractor needs approval of submittal.

1.4 PROCEDURES FOR SUBMITTALS

1.4.1 Reviewing, Certifying, Approving Authority

Contractor shall be responsible for reviewing and certifying that submittals are in compliance with contract requirements.

1.4.2 Constraints

a. Submittals listed or specified in this contract shall conform to provisions of this section, unless explicitly stated otherwise.

b. Submittals shall be complete for each definable feature of work; components of definable feature interrelated as a system shall be submitted at same time.

c. When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, submittal will be returned without review.

d. Approval of a separate material, product, or component does not imply approval of assembly in which item functions.

1.4.3 Scheduling

a. Coordinate scheduling, sequencing, preparing and processing of

submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential requirements to resubmit.

b. Except as specified otherwise, allow review period, beginning with receipt by approving authority, that includes at least 10 working days for submittals for Architect approval and 15 working days for submittals requiring Owner, and Architect's approval. Period of review for submittals begins when Architect receives submittal from Contractor. Period of review for each resubmittal is the same as for initial submittal.

1.4.4 Variations

Variations from contract requirements require Owner's approval, and will be considered where advantageous to the Owner. When proposing a variation, submit a written request to the Architect, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to the Owner. If lower cost is a benefit, also include an estimate of the cost of saving. Identify the proposed variation separately and include the documentation for the proposed variation along with the required submittal for the item. When submitting a variation for approval, the Contractor warrants the following:

1.4.4.1 Variation is Compatible

The Contract has been reviewed to establish that the variation, if incorporated, will be compatible with the other elements of the work.

1.4.4.2 Review Schedule Is Modified

In addition to normal submittal review period, a period of 10 working days will be allowed for consideration by the Owner of submittals with variations.

1.4.5 Contractor's Responsibilities

a. Determine and verify field measurements, materials, field construction criteria; review each submittal; and check and coordinate each submittal with requirements of the work and contract documents.

b. Transmit submittals to Architect in accordance with schedule on approved Submittal Register, and to prevent delays in the work, delays to Owner, or delays to separate contractors.

c. Advise Architect of variation, as required by paragraph entitled "Variations."

d. Correct and resubmit submittal as directed by approving authority. When resubmitting disapproved transmittals or transmittals noted for resubmittal, the contractor shall provide copy of that previously submitted transmittal including all reviewer comments for use by approving authority. Direct specific attention in writing or on resubmitted submittal, to revisions not requested by approving authority on previous submissions.

e. Furnish additional copies of submittal when requested by Owner or Architect, to a limit of 20 total copies per submittal.

f. Complete work which must be accomplished as basis of a submittal in time to allow submittal to occur as scheduled.

g. Ensure no work has begun until submittals for that work have been returned as "no exceptions taken," or "make corrections noted", except to the extent that a portion of work must be accomplished as basis of submittal.

1.4.6 Architect Responsibilities

a. Note date on which submittal was received from contractor on each submittal.

b. Review each submittal; and check and coordinate each submittal with requirements of work and contract documents.

c. Review submittals for conformance with project design concepts and compliance with contract documents.

d. Take appropriate action on submittal from the possible actions defined in paragraph entitled, "Actions Possible."

e. Ensure that material is clearly legible.

f. Stamp each sheet of each submittal with Architect's statement, except that data submitted in bound volume or on one sheet printed on two sides may be stamped on the front of the first sheet only.

g. Update submittal register as submittal actions occur and maintain the submittal register until final acceptance of all work by Architect.

i. Retain one copy of approved submittals approved samples.

1.4.7 Owner's Responsibilities

The Owner will:

a. Note date on which submittal was received from Engineer/Architect, on each submittal for which the Owner's review is required.

b. Review submittals within period specified.

c. Identify returned submittals with one of the actions defined in paragraph entitled "Actions Possible" and with markings appropriate for action indicated.

1.4.8 Actions Possible

Submittals will be returned with one of the following notations:

a. Submittals marked "not reviewed" will indicate submittal has been previously reviewed and approved, is not required , does not have evidence of being reviewed and approved by contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by contractor or for being incomplete, with appropriate action, coordination, or change.

b. Submittals marked "no exceptions taken" authorize contractor to proceed with work covered.

c. Submittals marked "make correction noted" authorize contractor to proceed with work as noted provided contractor takes no exception to the notations.

d. Submittals marked "revise and resubmit" or "rejected" indicate submittal is incomplete or does not comply with design concept or requirements of the contract documents and shall be resubmitted with appropriate changes. No work shall proceed for this item until resubmittal is approved.

1.5 FORMAT OF SUBMITTALS

1.5.1 Transmittal Form

Transmit each submittal, except sample installations and sample panels, to Architect. Transmit submittals with transmittal form standard for project. The transmittal form shall identify contractor, indicate date of submittal, and include information prescribed by transmittal form and required in paragraph entitled "Identifying Submittals." Process transmittal forms to record actions regarding sample panels and sample installations.

1.5.2 Identifying Submittals

Identify submittals, except sample panel and sample installation, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

a. Project title and location.

b. Construction contract number.

c. Section number of the specification section by which submittal is required.

d. When a resubmission, alphabetic suffix on submittal description, to indicate resubmission.

e. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other second tier contractor associated with submittal.

f. Product identification and location in project.

1.5.3 Format for Product Data

a. Present product data submittals for each section as a complete, bound volume. Include table of contents, listing page and catalog item numbers for product data.

b. Indicate, by prominent notation, each product which is being submitted; indicate specification section number and paragraph number to which it pertains.

c. Supplement product data with material prepared for project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for project.

d. Provide adequate space on submittal for Architect's and Contractor's review stamp.

1.5.4 Format for Shop Drawings

a. Shop drawings shall not be less than 8 1/2 by 11 inches nor more than 30 by 42 inches.

b. Present 8 1/2 by 11 inches sized shop drawings as part of the bound volume for submittals required by section. Present larger drawings in sets.

c. Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph entitled "Identifying Submittals."

d. Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with other trades to scale. Shop drawing dimensions shall be the same unit of measure as indicated on the contract drawings. Identify materials and products for work shown.

1.5.5 Format of Samples

a. Furnish samples in sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples of approximately same size as specified:

(1) Sample of Equipment or Device: Full size.

(2) Sample of Materials Less Than 2 by 3 inches: Built up to 8 1/2 by 11 inches.

(3) Sample of Materials Exceeding 8 1/2 by 11 inches: Cut down to 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.

(4) Sample of Linear Devices or Materials: 10 inch length or length to be supplied, if less than 10 inches. Examples of linear devices or materials are conduit and handrails.

(5) Sample of Non-Solid Materials: Pint. Examples of non-solid materials are sand and paint.

(6) Color Selection Samples: 2 by 4 inches.

(7) Sample Panel: 4 by 4 feet.

(8) Sample Installation: 100 square feet.

b. Samples Showing Range of Variation: Where variations are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle of range.

c. Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporated samples shall be in undamaged condition at time of use.

d. Recording of Sample Installation: Note and preserve the notation of area constituting sample installation but remove notation at final clean up of project.

e. When color, texture or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

1.5.6 Format of Administrative Submittals

a. When submittal includes a document which is to be used in project or become part of project record, other than as a submittal, do not apply contractor's approval stamp to document, but to a separate sheet accompanying document.

b. Operation and Maintenance Manual Data: Submit in accordance with Section 01781, "Operation and Maintenance Data." Include components required in that section and the various technical sections.

1.6 QUANTITY OF SUBMITTALS

1.6.1 Number of Copies

a. Submit six copies of submittals of product data and shop drawings. One copy will be retained by the Owner, one copy will be retained by the Architect, and the remainder will be returned to the Contractor.

1.6.2 Number of Samples

a. Submit two samples, or two sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by the Architect and one will be returned to contractor.

b. Submit one sample panel. Include components listed in technical section or as directed.

c. Submit one sample installation, where directed.

d. Submit one sample of non-solid materials.

1.6.3 Number of Copies of Administrative Submittals

a. Unless otherwise specified, submit administrative submittals compliance with quantity requirements specified for product data.

b. Submit administrative submittals required under "SD-19 Operation and Maintenance Manuals" to conform to Section 01781, "Operation and Maintenance Data."

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

SECTION 01400

QUALITY CONTROL

PART 1 GENERAL

1.1 RELATED SECTIONS

a. Section 01300 - Submittals: Submission of manufacturers' instructions and certificates.

b. Section 01600 - Material and Equipment: Requirements for material and product quality.

1.2 QUALITY ASSURANCE - CONTROL OF INSTALLATION

a. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.

b. Comply with manufacturers' instructions, including each step in sequence.

c. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding. No additional costs will be allowed due to manufacturer's requirements.

d. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

e. Perform work by persons qualified to produce workmanship of specified quality.

f. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.3 TOLERANCES

a. Monitor tolerance control of installed Products to produceacceptable Work. Do not permit tolerances to accumulate.

b. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Owner's Representative before proceeding.

c. Verify Products meet appropriate dimensions; position before securing Products in place.

1.4 INSPECTING AND TESTING LABORATORY SERVICES

a. Owner will appoint, employ, and pay for specified services of an independent firm to perform inspecting and testing for the benefit of the Owner. The employment of this firm does not relieve the

contractor from its efforts to achieve specified quality.

b. The independent firm will perform inspections, tests, and other services as specified to be performed by the independent firm in individual specification sections and as required by the Owner.

c. Inspecting, testing, and source quality control may occur on or off the project site. Provide access for the independent testing firm to perform off-site inspecting or testing as required by the Owner.

d. Reports will be submitted by the independent firm to the Architect, Owner, and Contractor, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

e. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.

1. Notify independent firm no later than 24 hours prior to expected time for operations requiring services.

2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

f. Independent testing or inspecting does not relieve Contractor of his obligation to perform Work to contract requirements.

g. Retesting , or re-inspection required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Architect. Payment for retesting or re-inspectionwill be charged to the Contractor by deducting inspecting or testing charges from the Contract Sum/Price.

h. The independent testing & inspection firm is not provided for the convenience of the contractor. The contractor shall schedule the work in a manner to minimize the number of trips to the site required to complete inspection services. Fees for frivolous use of the testing and inspection firm as determined by the Architect and/or the Owner will be deducted from the Contract Sum/Price.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

To assist in understanding the extent of special inspections required for this project, refer to Form CO-6b in the front of the project manual. This schedule lists the special inspections required and who will be conducting the inspections.

-- End of Section --

SECTION 01450

INDOOR AIR QUALITY MANAGEMENT

PART 1 GENERAL

1.1 SUMMARY

A. The General Contractor and Subcontractors shall implement the following procedures in an effort to improve indoor air quality during the Owner's occupancy. The General Contractor and Subcontractors shall implement the full Construction Indoor Air Quality (IAQ) Management Plan as required by LEED for New Construction, Version 2.2, Indoor Environmental Quality (IEQ) Credit 3, parts 1 and 2, including but not limited to the following as outlined within this Section and in the Sections referenced herein:

1. HVAC Protection
2. Source Control
3. Pathway Interruption
4. Housekeeping
5. Scheduling

B. Related sections: The following sections contain requirements that relate to this section:

1. Division 1 Section "LEED Green Building Rating Summary Requirements" for LEED Green Building Rating System TM compliance and documentation requirements.

1.2 REFERENCES

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA IAQ	IAQ Guidelines for Occupied Buildings Under Construction, Chapter 3 "Control Measures".

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52.2	(1999) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

US Green Building Council (USGBC)

USGBC	LEED Green Building Rating System, Version 2.2: 1. Indoor Environmental Quality (IEQ)

	Credit 3 "Construction IAQ Management Plan"
	2. Indoor Environmental Quality (IEQ) Credit 4 "Low Emitting Materials"
USGBC	LEED for New Construction and Major Renovations Version 2.2 Reference Guide

Green Seal (GS)

Standard GS-36	Commercial Adhesives

1.3 SUBMITTALS

A. Submit for approval a detailed Construction Indoor Air Quality Management Plan in accordance with the requirements of USGBC LEED 2.2 Indoor Environmental Quality Credit 3, parts 1 and 2 and as outlined in this Section, including but not limited to the following:

1. Detailed products and procedures for compliance with the execution requirements outlined in Part 3 of this Section. Narrative must include total and unit based control measures per phase.

2. Schedule for storage, installation and protection of all components of air distribution systems.

3. Schedule for storage, installation and protection of absorptive materials highlighting critical methods used to protect absorptive materials from dust, debris, moisture, gaseous and microbial contamination.

4. Proposed cleaning products and, if needed, proposed pest control products.

1.4 PROJECT MEETINGS

A. Construction indoor air quality management plans and implementation shall be discussed at the following meetings:

1. Work-initiation conference

2. Pre-installation conferences

3. Progress meetings

4. Coordination meetings

5. Owner's meetings

PART 2 PRODUCTS

2.1 AIR FILTRATION MEDIA

A. Minimum Efficiency Reporting Value (MERV) as determined by ASHRAE 52.2:

1. MERV-8 for filtration media used at each GSHP if used HVAC equipment is used during construction.

2.2 CLEANING PRODUCTS AND EQUIPMENT

A. The least toxic and lowest-emitting practical spot removers and cleaning agents shall be used for each given application.

B. HEPA-filter equipped vacuum cleaners shall be used for the final cleaning.

PART 3 EXECUTION

3.1 HVAC PROTECTION

A. If permanent HVAC is used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 must be used at each return air grill, as determined by ASHRAE 52.2, and all HVAC systems, equipment and pathways shall be dust and particulate free at the time of substantial completion of that phase of construction, in accordance with SMACNA IAQ Guidelines for Occupied Buildings Under Construction."

1. Replace filters during construction as necessary to protect equipment and indoor air quality.

B. HVAC supply and return ductwork, registers and equipment shall be kept clean, free of dust, debris, moisture, gaseous and microbial contamination during storage, handling installation and punch-out.

C. Leaks in return ducts and air handlers shall be checked and repaired. Avoid using the mechanical rooms for construction storage.

D. After each phase of construction, install new filtration media throughout the HVAC system. Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 8 as determined by ASHRAE 52.2.

E. After the final phase of construction, install new filtration media throughout the HVAC system. Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 8 as determined by ASHRAE 52.2.

3.2 SOURCE CONTROL

A. Comply with the Product specifications, including SCAQMD, Green Seal, Green Seal Plus and CRI standards referenced herein, for Low-Emitting Materials (LEED IEQ Credit 4) in specific Products Specifications, including but not limited to those contained within the following Sections:

1. 06105 - Miscellaneous Carpentry
2. 06402 - Interior Architectural Woodwork
3. 07841 - Through-Penetration Firestop Systems
4. 07920 - Joint Sealants
5. 09310 - Ceramic Tile
6. 09651 - Resilient Floor Tile
7. 09653 - Resilient Wall Base and Accessories
8. 09680 - Carpet
9. 09841 - Acoustical Wall Panels
10. 09911 - Interior Painting
11. 15010 - Mechanical General Provisions
12. 15050 - Basic Piping Materials and Methods
13. 15079 - Firestopping for Mechanical Work
14. 15810 - Ducts

B. Adhesives not specified in the above sections shall comply with the current VOC Content limits, as expressed in grams per liter, of SCAQMD Rule 1168 "Adhesive and Sealant Applications", amended January 7, 2005, as follows:

1. Indoor Carpet & Pad Adhesives: 50
2. Wood Flooring Adhesive: 100
3. Rubber Floor Adhesives: 60
4. Subfloor Adhesives: 50
5. Ceramic Tile Adhesives: 65
6. VCT and Asphalt Tile (& Linoleum) Adhesives: 50
7. Dry Wall and Panel Adhesives: 50
8. Cove Base Adhesives: 50
9. Multipurpose Construction Adhesives: 70
10. Structural Glazing Adhesives: 100
11. PVC Welding: 510
12. CPVC Welding: 490
13. ABS Welding: 325
14. Plastic Cement Welding: 250
15. Adhesive Primer for Plastic: 550
16. Contact Adhesive: 80
17. All Other Welding & Installation Adhesives 250
18. Metal to metal substrates: 30
19. Plastic foam substrate: 50
20. Porous substrate except wood: 50
21. Wood substrate: 30
22. Fiberglass substrate: 80

C. Aerosol Adhesives not specified in the above sections shall comply with the current VOC Content limits, as expressed in percentage of VOCs by weight, of Green Seal (GS) Standard GS-36 "Commercial Adhesives," October 19, 2000 (for aerosol adhesives only) as follows:

1. General Purpose Mist Spray: 65 percent VOCs by weight
2. General Purpose Web Spray: 55 percent VOCs by weight
3. Special Purpose Aerosol Adhesives (all types): 70 percent VOCs by weight

D. Prohibit smoking on the inside of the building and near doors, windows and intakes.

E. Provide direct exhaust to the exterior during installation of strong emitting materials, including touch-up activities if applicable. Keep exhaust away from intakes and occupied spaces.

F. Protect "absorptive" materials (which are woven, fibrous or porous in nature, such as carpet, ceiling tiles, insulation, and fabrics) from exposure to dust, debris and moisture contamination during product delivery, storage and handling from construction/ demolition and punch-out activities.

G. "Bake-out" or "super-heating" of spaces to accelerate the release of gaseous emissions is not permitted.

3.3 PATHWAY INTERUPTION

A. Where possible, provide negative pressurization of spaces under construction and/or demolition and positive pressurization of occupied or finished spaces while construction work proceeds in adjacent areas.

B. Ventilate using 100 percent outside air to exhaust contaminated air directly to the outside during installation of VOC-emitting materials.

C. Where applicable, erect plastic barriers to contain construction areas.

D. Relocate pollutant sources when project equipment or staging areas coincide with critical air flow pathways.

E. Temporarily seal the building, including air intakes and exhaust vents, and any other building openings, when dust-generating or strong-emitting construction products or procedures are used on the exterior of the building.

F. Once spaces within the building become occupied, work areas must remain under negative pressure. Exhaust air at a rate at least 10 percent greater than the rate of supply. Do not exhaust air where it can be drawn back into occupied spaces.

G. Once spaces within the building become occupied, erect barriers to contain construction areas. Barriers to consist of a continuous plastic seal between the construction area and occupied spaces.

3.4 HOUSEKEEPING

A. Suppress dust during construction and/or demolition activities with wetting agents or sweeping compounds.

B. Broom clean and vacuum the floors to keep dust from accumulating during construction and/or demolition.

C. Ensure that food and food packaging are not left on the jobsite.

D. Give preference to low-toxic pest control chemicals, if needed.

E. Final cleaning shall be detailed and shall use a HEPA-filter vacuum throughout.

F. Remove spills or excess application of solvent-containing products as soon as possible. Use low-emitting cleaning agents described under CLEANING PRODUCTS AND EQUIPMENT.

G. Keep work areas as dry as possible. Replace any absorptive material that is exposed to moisture longer than four hours.

3.5 SCHEDULING

A. Coordinate construction activities to minimizer or eliminate disruption of operations in occupied portions of the building.

B. Protect "absorptive" materials (which are woven, fibrous or porous in nature, such as carpet, ceiling tiles, insulation, and fabrics) from exposure to emissions during and after installation from materials and finishes with the potential for short-term release of off-gassing volatile organic compounds by sequencing the installation of "absorptive" materials after odor-emitting activities have occurred and have been mitigated by ventilation.

C. If protection measures as described above cannot be ensured for

"absorptive" materials during storage, do not store these materials on-site.

-- End of Section --

SECTION 01500

TEMPORARY CONSTRUCTION FACILITIES

PART 1 GENERAL

The following sections describe temporary services and procedures utilized during construction. All utility services and their fees and costs are the responsibility of the Contractor until final acceptance by the Owner.

1.1 RELATED SECTIONS

a. Section 01590 - Field Offices and Sheds.

b. Section 01700 - Contract Closeout: Final cleaning.

1.2 TEMPORARY ELECTRICITY

a. Cost: By Contractor; provide and pay for power service required from utility source.

b. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required. Provide flexible power cords as required.

1.3 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

a. Provide and maintain lighting for construction operations to achieve a minimum lighting level of 2 watt/sq ft.

b. The contractor is responsible for maintaining security at the site. Any security lighting shall minimize impact on surrounding sites and roads.

c. Maintain lighting and provide routine repairs.

d. Permanent building lighting may be utilized during construction. Provide replacement lamps to Owner at Substantial Completion, in accordance with Sectin 01700.

1.4 TEMPORARY HEAT

a. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.

b. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

1.5 TEMPORARY VENTILATION

a. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.6 TEMPORARY WATER SERVICE

a. The contractor shall pay for connection to, and usage of on-site water service for construction operations. At the completion of construction the construction water connection shall be permanently removed.

1.7 TEMPORARY SANITARY FACILITIES

a. Provide and maintain required facilities and enclosures.

1.8 BARRIERS

a. Provide protection to prevent unauthorized entry to construction areas, and to protect adjacent properties from damage from construction operations and demolition. Devices, barriers, and methods shall be in accordance with IBC, Chapter 33, specifically Section 3306 and LEED Referenced Standards, see Section 01150 "LEED Summary Requirements and Goals".

b. Provide protection using orange plastic mesh fencing for plant life designated to remain. Replace damaged plant life.

c. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.9 WATER CONTROL

a. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

b. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion. See civil sheets for further detail.

1.10 PROTECTION OF INSTALLED WORK

a. Protect installed Work and provide special protection where specified in individual specification sections.

b. Provide temporary and removable protection for installed Products. Control activity in immediate work area to prevent damage.

c. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

d. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

e. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

f. Prohibit traffic from landscaped areas.

1.11 ACCESS ROADS

a. Construct and maintain temporary roads accessing public thoroughfares to serve construction area. Construction traffic and staging areas must not obstruct roads.

1.12 PARKING

a. Use existing on-site parking areas to accommodate construction personnel. Parking along existing roads and in right-of-way is prohibited. Parking at adjacent sites is prohibited without Owner's expressed permission. Restore existing parking area to like-new condition oat the completion of construction.

b. When site space is not adequate, arrange for and provide additional off-site parking or transportation arrangements.

1.13 PROGRESS CLEANING AND WASTE REMOVAL

a. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

b. Remove debris and rubbish from pipe chases, plenums, attics, and other closed or remote spaces, prior to enclosing the space.

c. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

d. Collect and remove waste materials, debris, and rubbish from site weekly, or more frequently if necessary, and properly dispose off-site.

1.14 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

a. Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion inspection.

b. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.

c. Clean and repair damage caused by installation or use of temporary work.

PART 2 PRODUCTS
Not Used.

PART 3 EXECUTION
Not used.

--End of Section--

SECTION 01550

CONSTRUCTION WASTE MANAGEMENT

PART 1 GENERAL

1.1 SUMMARY

A. The General Contractor and Subcontractors shall minimize the creation of construction and demolition waste on the job site and shall minimize waste sent to landfills.

B. The General Contractor and Subcontractors shall implement the full Construction Waste Management Plan as required by LEED for New Construction, Version 2.2, Materials Credit 2, part 1 and possibly part 2, including but not limited to the requirements outlined within this Section and in the Sections referenced herein.

C. Compost, recycle, salvage, or donate a minimum of 50% (or 75%) by weight or volume of total non-hazardous project construction and demolition debris, excluding excavated soil and land-clearing debris, and including but not limited to the following:

1. Asphalt paving
2. Concrete and concrete pavers
3. Bricks and brick pavers
4. Concrete Masonry Units (CMUs)
5. Ferrous and non-ferrous metals
6. Clean, untreated, unpainted dimensional wood, free of nails or other fasteners (wood pallets may be acceptable with paint and/or fasteners)
7. Plywood, OSB, and particleboard
8. Plastics
9. Roofing materials
10. Glass
11. Gypsum board (unpainted)
12. Acoustical tile
13. Carpet and pad
14. Insulation
15. Leftover paint (kept in its original container)
16. Light bulbs and tubes
17. Beverage containers (plastic, glass and metal)
18. Corrugated cardboard
19. Mixed paper

D. Related sections: The following sections contain requirements that relate to this section:

1. Division 1 Section "[LEED] Green Building Rating Summary Requirements" for LEED Green Building Rating System TM compliance and documentation requirements.

2. Division 2 Sections "Clearing" and "Demolition".

1.2 SUBMITTALS

A. Prior to any waste removal, submit for approval a detailed Construction and Demolition Waste Management Plan in accordance with the requirements of LEED 2.2 Construction Waste Management Plan as required by LEED 2.2 Materials Credit 2, parts 1 and possibly part 2, as outlined in this Section, including but not limited to the following:

1. Analysis of the estimated job-site waste to be generated, including types and quantities of compostable, recyclable and salvageable materials.

2. Description of the means and methods to achieve the 50% (or 75%) diversion requirement for compostable, recyclable, and salvageable materials, including those that may be donated to a charitable orgainzation.

3. Identification of recycling contractors proposed for use in the project, locations accepting construction waste materials or entities providing related services by utilizing the References or by contacting the Recycling Specialist, as listed in this Section.

B. Waste Management Progress Reports: Submit monthly, including the following information:

1. Project title, name of party completing report, and dates of period covered by the report

2. Amount (by weight or volume) of Project waste material landfilled and identity of the landfill(s).

3. For each material composted, recycled, salvaged or donated from the Project, provide the following:

a. Amount (by weight or volume)
b. Date(s) removed from the job site
c. Receiving party
d. Disposal Cost: Bin rental and facility fees
e. Transportation Cost: Hauling
f. Money paid or received for recycled or salvaged material.
g. Brief description of what was done with the material

4. Updated LEED 2.2 Letter Template Spreadsheet including the amount (by weight or volume) of recycled and/or salvaged construction, demolition, and land clearing waste.

C. Final Waste Management Report: At completion of construction submit comprehensive tracking log. Include the following information in addition to details stated above.

1. Overall Disposal Costs

2. Overall Transportation Costs

3. Total money paid or received for recycled or salvaged material; total value provided for donated materials.

4. Include legible copies of on-site logs, manifests, weight tickets, and receipts.

5. Final LEED 2.2 Letter Template Spreadsheet including the total amount (by weight) of recycled and/or salvaged and/or donated construction and demolition waste and the total amount (by weight or volume) of landfilled waste.

1.3 PROJECT MEETINGS

A. Waste management plans and implementation shall be discussed at the following meetings:

1. Work-initiation conference

2. Pre-installation conferences

3. Progress meetings

4. Coordination meetings

5. Owner's meetings

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 WASTE MANAGEMENT PLAN IMPLEMENTATION, GENERAL

A. Inform all trades regarding all construction and demolition waste recycling requirements relevant to their work. Provide on-site instruction of appropriate separation, handling and recycling methods for construction personnel.

B. Designate at least one specific area for separation of material for salvage and recycling. Keep recycling and waste bin areas neat and clean and clearly marked.

C. Maintain an on-site log, which includes required reporting information for each load of materials removed from site.

D. Separate, store and dispose of hazardous wastes separately and in accordance with local regulations. Do not handle, separate, store, salvage, or recycle hazardous materials with other materials.

E. Coordinate work of recycling, composting and salvaging waste haulers with other trades.

-- End of Section --

SECTION 01590

FIELD OFFICES AND SHEDS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Temporary field offices, storage sheds, or work sheds furnished, installed, and maintained during the entire construction period or as needed for construction.

1. Before installation of offices and sheds, consult with the Owner for locations, access, and related facilities.

1.2 REQUIREMENTS

A. Construction of Field Offices and Sheds:

1. Structurally sound, weathertight, with floor raised aboveground.

2. Temperature Transmission Resistance: Compatib;e with human occupancy and storage requirements.

3. At Contractor's option, portable or mobile buildings specifically designed for mobile office use may be used.

B. Year Round Hurricane Precautions: Provide appropriate tiedowns for temporary trailers, field offices, and sheda to be capable of withstanding wind velocity pressures according to American Society of Civil Engineers ASCE 7-98

1.3 FIELD OFFICE

A. Contractor's Field Office:

1. Size as required for general use and to provide space for project meetings.

2. Services:

a. Lighting: 50 foot-candles at desk top height.

b. Enterior lighting at entrance door.

c. Automatic heating and mechanical cooling equipment to maintain human comfort conditions.

d. Minimum of four 110 volt duplex electric convenience outlets, at least 1 on eash wall of major spaces.

e. Electric Distribution panel: Two circuits minimum, 110 volt, 60 hertz service.

f. Drinking water and toilet facilities.

g. Telephone: Direct line instrument. Refer to Section 01510 - Temporary Utilities for additional information.

h. Photocopier available for use by the Owner and A/E.

i. Facsimile machine available for use by the owner and A/E.

3. Meeting Area Furnishings:

a. Conference table and chairs for at least 8 persons.

b. Racks and files for Project record Documents in or nect to the meeting area.

c. Other Furnishings: Contractor's Option.

d. Provide electraical, lighting, and telephone services as necessary.

4. One 10 inch outdoor-type thermometer.

B. Owner's Field Office: provide an adjacent air-conditioned and heated field office trailer.

1. A minimum area of 120 square feet of space, adequately lighted, with electrical service and receptacles for normal office aids.

2. Furnishings: Include one secretarial type desk and chari, on table approximately 3 feet by 6 feet, one lockable four drawer letter size file cabinet, and a vertical blueprint rack.

3. Provide a desk telephone in the Owner's office for the Owners exclusive use. Provide a separate telephone line for modem access unless high-speed Internet access, is available to the site. In such case, high-speed Internet access shall be made available to the owner (unlimited use).

4. Cost of telephone installation shall be paid by Contractor and long distance calls made by the Owner will be paied by the Owner.

1.4 STORAGE SHEDS

A. As required of various trades.

B. Dimensions: Adequate for storage and handling of products.

C. Ventilation: Comply with specified and code requirements for products stored.

PART 2 PRODUCTS

2.1 MATERIALS, EQUIPMENT, AND FURNISHINGS

A. Serviceable, adequate for required purpose, and not violating applicable codes or requlations.

PART 3 EXECUTION

3.1 INSTALLATION

A. Locate field offices on the existing parking ares, with convient access for visitors to the site.

B. Located temporary field offices and storage sheds on proper temporary foundations without damaging existing pavement. provide connections for utility services.

1. Secure portable or mobile huildings, when used, against break-ins and hurricane requirements per code.

2. Provide slip-resistant steps and landings at entrance doors.

C. Mount thermometer at concenient outside, continuously shaded location.

3.2 MAINTENANCE AND CLEANING

A. Provide periodic maintenance and cleaning for temporary structures, furnishings, equipment, and services.

3.3 REMOVALS

A. Remove temporary field offices, contents, and services when no longer needed.

B. Remove storage sheds when no longer needed.

C. Remove foundations and debris, grade site to specified elevations, and complete remaining site work indicated on Construction Documents.

-- End of Section --

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

Requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 TRANSPORTATION, HANDLING AND PROTECTION OF MATERIAL AND EQUIPMENT

a. Shipments shall be addressed to the Contractor who shall be responsible for their receipt, unloading, handling, and storage at the site.

b. Transport and handle products in accordance with manufacturer's instructions

c. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

d. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.3 STORAGE AND PROTECTION OF MATERIAL

a. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight, climate controlled enclosures.

b. For exterior storage of fabricated products, place on sloped supports, above ground.

c. Provide off-site storage and protection when site does not permit on-site storage or protection.

d. Cover products subject to deterioration with imperious sheet covering. Provide ventilation to avoid condensation.

e. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

f. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

g. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.

h. Coordinate with additional requirements of Section 01450 "Indoor Air Quality Management.

PART 2 PRODUCTS

2.1 MECHANICAL MATERIALS AND EQUIPMENT

Materials and equipment to be provided under this contract shall be standard catalogue products of manufacturers regularly engaged in the manufacture of the products.

Material and equipment shall be installed in accordance with the requirements of the contract drawings and approved recommendations of the manufacturers.

2.2 PRODUCT OPTIONS

a. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.

b. Products Specified by Naming One or More Manufacturers: Products of manufacturers named and meeting specifications, no options or substitutions allowed.

c. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution in accordance with CO-7 General Conditions of the construction Contract.

2.3 SUBSTITUTIONS

a. Refer to CO-7, General Conditions of the construction Contract for substitution procedure.

PART 3 EXECUTION (Not Applicable)

-- End of Section --

SECTION 01700

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 CLOSEOUT PROCEDURES

a. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect's inspection.

b. Provide submittals to Owner that are required by governing or other authorities.

c. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.2 FINAL CLEANING

a. Execute final cleaning prior to final inspection.

b. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

c. Clean equipment and fixtures to a sanitary condition.

d. Replace filters of operating equipment.

e. Clean debris from roofs, downspouts, and drainage systems.

f. Clean site; sweep paved areas, rake clean landscaped surfaces.

g. Remove waste and surplus materials, rubbish, and construction facilities from the site.

h. For all interior lighting fixtures used during construction provide replacement stock for lamps to the Owner for the Owner's use (100% replacement).

1.3 ADJUSTING

a. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.4 PROJECT RECORD DOCUMENTS

a. Maintain on site, one set of the following record documents; record actual revisions to the Work:
   1. Contract Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other Modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.

6. Maintain one copy of the approved documents (drawings and specifications) on-site, available for review.

b. Store Record Documents separate from documents used for construction.

c. Record information concurrent with construction progress.

d. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and Modifications.

e. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured depths of foundations in relation to finish floor datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
4. Field changes of dimension and detail.
5. Details not on original Contract Drawings.

f. Submit documents to Architect.

1.5 OPERATION AND MAINTENANCE DATA

Provide operation and maintenance data in accordance with Section 01781.

1.6 PROVISIONS

a. Provide duplicate notarized copies to the Architect.

b. Execute and assemble documents from Subcontractors, suppliers, and manufacturers.

c. Provide Table of Contents and assemble in three D size ring binder with durable plastic cover.

d. Submit prior to final Application for Payment.

e. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.7 SPARE PARTS AND MAINTENANCE MATERIALS

a. Provide products, spare parts, maintenance and extra materials in quantities specified in in dividual specification Sections.

b. Deliver to Project site and place in location as directed; obtain receipt, signed by Owner's designated representative, prior to final payment.

1.8 COMMISSIONING

A. Coordinate with requirements of Section 01810 "General Commissioning Requirements" and Section 01815 "HVAC Commissioning Requirements.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

SECTION 01781

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. The O&M data submittal shall consist of printed and electronic copies of O&M Data and an electronic Inventory Condition Assessment Database. Submit in accordance with this section and Section 01300 SUBMITTAL PROCEDURES.

1.1.1 O&M Data Manual

O&M Data Manuals shall contain manufacturer's original printed product information. Documents shall be fully legible. Photocopies and material with hole punches obliterating the text or drawings will not be accepted. The O&M Data Manual shall be fully tabulated, indexed and consolidated in multiple, matching 3", three ring binders. Electronic O&M Data Manual documents shall be publication quality, in a searchable electronic format such as Microsoft Word or Adobe PDF.

1.1.1.1 Submittals

Submit three sets of printed O&M Data Manuals and two electronic copies of the O&M Data Manual on CD-ROM.

1.1.1.2 Content

O&M Data Manual content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data". Provide O&M Data information required by this section addressing each product, component, and system where O&M Data is required to be provided in the individual technical sections of this specification. Provide additional O&M Data information where specified in the individual technical sections.

1.1.2 Inventory Condition Assessment Database

The Inventory Condition Assessment Database shall be a stand-alone, web-based, facilities management database application. Database application shall include the ability to store and retrieve graphic information including plans, photos, and diagrams as well as text and numerical data. Graphic information provided in the database shall also be completely coded into the database for comprehensive searching and cross referencing of graphically depicted information. The database shall be expandable to allow the owner to supplement the database over time. In addition to the requirements of the database application, provide the initial raw data in a universal format to allow for future transfer of data into a separate facilities management software program.

1.1.2.1 Submittals

Submit two electronic copies of the Inventory Condition Assessment Database Application and raw data on CD-ROM.

1.1.2.2 Content

Inventory Condition Assessment Database content shall be as shown in the paragraph titled "Schedule of Inventory Condition Assessment Database Information". Provide database information required by this section addressing each product, component, and system where database information is required to be provided in the individual technical sections of this specification. Provide additional database information where specified in the individual technical sections.

1.1.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Changes, additions, or revisions required by the Owner for final acceptance of submitted data shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

1.2 TYPES OF INFORMATION REQUIRED IN O&M MANUAL AND DATABASE

1.2.1 Equipment and Systems Identification

Provide identification information for all installed equipment and systems including serial numbers. Identify equipment and systems by make, model, serial number, and complete nameplate data.

1.2.2 Product Technical Specifications

Provide manufacturer's technical specifications and performance requirements for all installed equipment and systems, including all major component items.

1.2.3 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation:

1.2.3.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.2.3.2 Operator Prestart

Include procedures required to set up and prepare each system for use.

1.2.3.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown, and Post-Shutdown operating procedures including the control sequence for each procedure.

1.2.3.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include

Control Diagrams with data to explain operation and control of systems and specific equipment.

1.2.3.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations, and zones or portions of systems controlled.

1.2.3.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gauge readings.

1.2.3.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component, or system. Describe conditions under which the equipment item should not be allowed to run.

1.2.4 Preventative Maintenance

Include the following information for preventative and scheduled maintenance to minimize corrective maintenance and repair.

1.2.4.1 Preventative Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventative maintenance, inspections, tests, and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventative maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation. Identify manufacturer's inspection requirements and test procedures including recommended technical personnel required for performing required inspections.

1.2.4.2 Lubrication Data

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph titled, "Operator Service Requirements":

a. A table showing recommended types of lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

c. A Lubrication Schedule showing service interval frequency.

1.2.5 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting

problems and making repairs.

1.2.5.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.2.5.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and the terminals for each type, identically to actual installation configuration and numbering.

1.2.5.3 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.2.5.4 Removal and Replacement Instructions

Include step-by-step procedures and a list of required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings, and adjustments required. Instructions shall include a combination of text and illustrations.

1.2.5.5 Spare Parts and Supply List

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. List spare parts and supplies that have a lead time greater than 30 days to obtain.

1.2.5.6 Corrective Maintenance Work Hours

Include manufacturer's projection of corrective maintenance work-hours by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

1.2.6 Anticipated Life Cycle

Include anticipated overall life cycle duration for equipment and systems. Life cycle analysis shall include timeframe for replacement vs. repair expectations and a corresponding anticipated life cycle cost based on strict adherence to maintenance schedules and normal operation.

1.2.7 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.2.7.1 Parts Identification

Provide identification and coverage for all parts of each equipment item, component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog.

1.2.7.2 Warranty Information

List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturer or the contract documents in order to keep warranties in force. Include warranty information for primary components such as the compressor of an air conditioning system.

1.2.7.3 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.2.7.4 Testing Procedures, Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.2.7.5 Contractor Information

Provide a list that includes the name, address, telephone number, fax number, and email address of the General Contractor and each Subcontractor who installed the product, or equipment, or system. For each item, also provide the name, address, telephone number, fax number, and email address of the manufacturer, the manufacturer's representative, and the service organization most convenient to the project site.

1.3 SCHEDULE OF OPERATION AND MAINTENANCE DATA

Furnish the following information to be included in the O&M Data Manual. Provide additional information where indicated in the individual technical sections.

a. Product Technical Specifications

b. Operating Instructions

c. Safety Precautions

d. Operator Prestart

e. Startup, Shutdown, and Post-Shutdown Procedures

f. Normal Operations

g. Emergency Operations

h. Operator Service Requirements

i. Environmental Conditions

j. Preventative Maintenance

k. Preventative Maintenance Plan and Schedule

l. Lubrication Data

m. Corrective Maintenance (Repair)

n. Troubleshooting Guides and Diagnostic Techniques

o. Wiring Diagrams and Control Diagrams

p. Maintenance and Repair Procedures

q. Removal and Replacement Instructions

r. Spare Parts and Supply List

s. Corrective Maintenance Work Hours

t. Parts Identification

u. Warranty Information

v. Personnel Training Requirements

w. Testing Procedures, Equipment and Special Tool Information

x. Contractor Information

1.4 SCHEDULE OF INVENTORY CONDITION ASSESSMENT DATABASE INFORMATION

Furnish the following information in an electronic database format for the owner's use to be included in the Inventory Condition Assessment Database application. Include additional information where indicated in the individual technical sections.

a. Equipment and Systems Identification

b. Product Technical Specifications

c. Operating Instructions

d. Safety Precautions

e. Operator Prestart

f. Startup, Shutdown, and Post-Shutdown Procedures

g. Normal Operations

h. Emergency Operations

i. Operator Service Requirements

j. Environmental Conditions

k. Preventative Maintenance

l. Preventative Maintenance Plan and Schedule

m. Lubrication Data

n. Corrective Maintenance (Repair)

o. Troubleshooting Guides and Diagnostic Techniques

p. Wiring Diagrams and Control Diagrams

q. Maintenance and Repair Procedures

r. Removal and Replacement Instructions

s. Spare Parts and Supply List

t. Corrective Maintenance Work Hours

u. Anticipated Life Cycle

v. Parts Identification

w. Warranty Information

x. Personnel Training Requirements

y. Testing Procedures, Equipment and Special Tool Information

z. Contractor Information

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

-- End of Section --

SECTION 01810

GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. OPR and BoD documentation prepared by Owner and Architect contains requirements that apply to this Section.

1.2 SUMMARY

A. This Section includes general requirements that apply to implementation of commissioning without regard to systems, subsystems, and equipment being commissioned.

B. Related Sections include the following:
1. Division 1 Section "HVAC Commissioning Requirements" for specific requirements for commissioning HVAC systems.

1.3 DEFINITIONS

A. BoD: Basis of Design.

B. CxA: Commissioning Authority.

C. OPR: Owner's Project Requirements.

D. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

E. TAB: Testing, Adjusting, and Balancing.

1.4 COMMISSIONING TEAM

A. Members Appointed by Contractor(s): Individuals, each having authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated actions. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:

1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.

2. Representatives of the facility user and operation and maintenance personnel.

3. Architect and engineering design professionals.

1.5 OWNER'S RESPONSIBILITIES

A. Provide the OPR documentation to the CxA and Contractor for use in developing the commissioning plan; systems manual; operation and maintenance training plan; and testing plans and checklists.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities including, but not limited to, the following:

1. Coordination meetings.

2. Training in operation and maintenance of systems, subsystems, and equipment.

3. Testing meetings.

4. Demonstration of operation of systems, subsystems, and equipment.

C. Provide utility services required for the commissioning process.

D. Provide the BoD documents, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.6 CONTRACTOR'S RESPONSIBILITIES

A. Provide utility services required for the commissioning process.

B. Contractor shall assign representatives with expertise and authority to act on behalf of the Contractor and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Participate in design- and construction-phase coordination meetings.

2. Participate in maintenance orientation and inspection.

3. Participate in operation and maintenance training sessions.

4. Participate in final review at acceptance meeting.

5. Certify that Work is complete and systems are operational according to the Contract Documents, including calibration of instrumentation and controls.

6. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.

7. Review and approve final commissioning documentation.

C. Subcontractors shall assign representatives with expertise and

authority to act on behalf of subcontractors and schedule them to participate in and perform commissioning team activities including, but not limited to, the following:

1. Participate in design- and construction-phase coordination meetings.

2. Participate in maintenance orientation and inspection.

3. Participate in procedures meeting for testing.

4. Participate in final review at acceptance meeting.

5. Provide schedule for operation and maintenance data submittals, equipment startup, and testing to CxA for incorporation into the commissioning plan. Update schedule on a weekly basis throughout the construction period.

6. Provide information to the CxA for developing construction-phase commissioning plan.

7. Participate in training sessions for Owner's operation and maintenance personnel.

8. Provide updated Project Record Documents to the CxA on a daily basis.

9. Gather and submit operation and maintenance data for systems, subsystems, and equipment to the CxA, as specified in Division 1 Section "Operation and Maintenance Data."

10. Provide technicians who are familiar with the construction and operation of installed systems and who shall develop specific test procedures and participate in testing of installed systems, subsystems, and equipment.

1.7 CxA'S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Prepare a construction-phase commissioning plan. Collaborate with Contractor and with subcontractors to develop test and inspection procedures. Include design changes and scheduled commissioning activities coordinated with overall Project schedule. Identify commissioning team member responsibilities, by name, firm, and trade specialty, for performance of each commissioning task.

C. Review and comment on submittals from Contractor for compliance with the OPR, BoD, Contract Documents, and construction-phase commissioning plan. Review and comment on performance expectations of systems and equipment and interfaces between systems relating to the OPR and BoD.

D. Convene commissioning team meetings for the purpose of coordination, communication, and conflict resolution; discuss progress of the commissioning processes. Responsibilities include arranging for facilities, preparing agenda and attendance lists, and notifying participants. The CxA shall prepare and distribute minutes to commissioning team members and attendees within five workdays of the commissioning meeting.

E. At the beginning of the construction phase, conduct an initial construction-phase coordination meeting for the purpose of reviewing the commissioning activities and establishing tentative schedules for operation and maintenance submittals; operation and maintenance training sessions; TAB Work; and Project completion.

F. Observe and inspect construction and report progress and deficiencies. In addition to compliance with the OPR, BoD, and Contract Documents, inspect systems and equipment installation for adequate accessibility for maintenance and component replacement or repair.

G. Prepare Project-specific test and inspection procedures and checklists.

H. Schedule, direct, witness, and document tests, inspections, and systems startup.

I. Compile test data, inspection reports, and certificates and include them in the systems manual and commissioning report.

J. Certify date of acceptance and startup for each item of equipment for start of warranty periods.

K. Review Project Record Documents for accuracy. Request revisions from Contractor to achieve accuracy. Project Record Documents requirements are specified in Division 1 Section "Project Record Documents."

L. Review and comment on operation and maintenance documentation and systems manual outline for compliance with the OPR, BoD, and Contract Documents. Operation and maintenance documentation requirements are specified in Division 1 Section "Operation and Maintenance Data."

M. Prepare commissioning reports.

N. Assemble the final commissioning documentation, including the commissioning report and Project Record Documents.

1.8 COMMISSIONING DOCUMENTATION

A. Index of Commissioning Documents: CxA shall prepare an index to include storage location of each document.

B. OPR: A written document, prepared by Owner, that details the functional requirements of Project and expectations of how it will be used and operated. This document includes Project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.

C. BoD Document: A document, prepared by Architect, that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

D. Commissioning Plan: A document, prepared by CxA, that outlines the schedule, allocation of resources, and documentation requirements of the commissioning process, and shall include, but is not limited to the following:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports. Identification of the relationship of these documents to other functions and a detailed description of submittals that are required to support the commissioning processes. Submittal dates shall include the latest date approved submittals must be received without adversely affecting commissioning plan.

2. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.

3. Identification of systems and equipment to be commissioned.

4. Description of schedules for testing procedures along with identification of parties involved in performing and verifying tests.

5. Identification of items that must be completed before the next operation can proceed.

6. Description of responsibilities of commissioning team members.

7. Description of observations to be made.

8. Description of requirements for operation and maintenance training, including required training materials.

9. Description of expected performance for systems, subsystems, equipment, and controls.

10. Schedule for commissioning activities with specific dates coordinated with overall construction schedule.

11. Identification of installed systems, subsystems, and equipment, including design changes that occurred during the construction phase.

12. Process and schedule for documenting changes on a continuous basis to appear in Project Record Documents.

13. Process and schedule for completing prestart and startup checklists for systems, subsystems, and equipment to be verified and tested.

14. Step-by-step procedures for testing systems, subsystems, and equipment with descriptions for methods of verifying relevant data, recording the results obtained, and listing parties involved in performing and verifying tests.

E. Test Checklists: CxA, with assistance of Architect, shall develop test checklists for each system, subsystem, or equipment including interfaces and interlocks, and include a separate entry, with space for comments, for each item to be tested. Prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. Provide space for testing personnel to sign off on each checklist. Specific checklist content requirements are specified in Division 1 Section "HVAC Commissioning Requirements." Each checklist, regardless of system, subsystem, or equipment being tested, shall include, but not be limited to, the following:

1. Name and identification code of tested item.

2. Test number.

3. Time and date of test.

4. Indication of whether the record is for a first test or retest following correction of a problem or issue.

5. Dated signatures of the person performing test and of the witness, if applicable.

6. Individuals present for test.

7. Deficiencies.

8. Issue number, if any, generated as the result of test.

F. Certificate of Readiness: Certificate of Readiness shall be signed by each Contractor, Subcontractor(s), Installer(s), and CxA certifying that systems, subsystems, equipment, and associated controls are ready for testing. Completed test checklists signed by the responsible parties shall accompany this certificate.

G. Test and Inspection Reports: CxA shall record test data, observations, and measurements on test checklists. Photographs, forms, and other means appropriate for the application shall be included with data. CxA shall compile test and inspection reports and test and inspection certificates and include them in systems manual and commissioning report.

H. Corrective Action Documents: CxA shall document corrective action taken for systems and equipment that fail tests. Include required modifications to systems and equipment and revisions to test procedures, if any. Retest systems and equipment requiring corrective action and document retest results.

I. Issues Log: CxA shall prepare and maintain an issues log that describes design, installation, and performance issues that are at variance with the OPR, BoD, and Contract Documents. Identify and track issues as they are encountered, documenting the status of unresolved and resolved issues.

1. Creating an Issues Log Entry:

a. Identify the issue with unique numeric or alphanumeric identifier by which the issue may be tracked.

b. Assign a descriptive title of the issue.

c. Identify date and time of the issue.

d. Identify test number of test being performed at the time of the observation, if applicable, for cross-reference.

e. Identify system, subsystem, and equipment to which the issue applies.

f. Identify location of system, subsystem, and equipment.

g. Include information that may be helpful in diagnosing or evaluating the issue.

h. Note recommended corrective action.

i. Identify commissioning team member responsible for corrective action.

j. Identify expected date of correction.

k. Identify person documenting the issue.

2. Documenting Issue Resolution:

a. Log date correction is completed or the issue is resolved.

b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.

c. Identify changes to the OPR, BoD, or Contract Documents that may require action.

d. State that correction was completed and system, subsystem, and equipment is ready for retest, if applicable.

e. Identify person(s) who corrected or resolved the issue.

f. Identify person(s) documenting the issue resolution.

3. Issues Log Report: On a periodic basis, but not less than for each commissioning team meeting, CxA shall prepare a written narrative for review of outstanding issues and a status update of the issues log. As a minimum, CxA shall include the following information in the issues log and expand it in the narrative:

a. Issue number and title.

b. Date of the identification of the issue.

c. Name of the commissioning team member assigned responsibility for resolution.

d. Expected date of correction.

J. Commissioning Report: CxA shall document results of the commissioning process including unresolved issues and performance of systems, subsystems, and equipment. The commissioning report shall indicate whether systems, subsystems, and equipment have been completed and are performing according to the OPR, BoD, and Contract Documents. The commissioning report shall include, but is not limited to, the following:

1. Lists and explanations of substitutions; compromises; variances in the OPR, BoD, and Contract Documents; record of conditions; and, if appropriate, recommendations for resolution. This report shall be used to evaluate systems, subsystems, and equipment and shall serve as a future reference document during Owner occupancy and operation. It shall describe components and performance that exceed requirements of the OPR, BoD, and Contract Documents and those that do not meet

requirements of the OPR, BoD, and Contract Documents. It may also include a recommendation for accepting or rejecting systems, subsystems, and equipment.

2. OPR and BoD documentation.

3. Commissioning plan.

4. Testing plans and reports.

5. Corrective modification documentation.

6. Issues log.

7. Completed test checklists.

8. Listing of off-season test(s) not performed and a schedule for their completion.

K. Systems Manual: Contractor shall gather required information and compile systems manual. Systems manual shall include, but is not limited to, the following:

1. OPR and BoD, including system narratives, schematics, and changes made throughout the Project.

2. Project Record Documents as specified in Division 1 Section "Project Record Documents."

3. Final commissioning plan.

4. Commissioning report.

5. Operation and maintenance data as specified in Division 1 Section "Operation and Maintenance Data."

1.9 SUBMITTALS

A. Commissioning Plan Prefinal Submittal: CxA shall submit three hard copies of prefinal commissioning plan. Deliver one copy to Contractor, one to Owner, and one to Architect. Present submittal in sufficient detail to evaluate data collection and arrangement process. One copy, with review comments, will be returned to the CxA for preparation of the final construction-phase commissioning plan.

B. Commissioning Plan Final Submittal: CxA shall submit two hard copies and two sets of electronically formatted information of final commissioning plan. Deliver one hard copy and one set of discs to Owner, and one copy to Architect. The final submittal must address previous review comments. The final submittal shall include a copy of the prefinal submittal review comments along with a response to each item.

C. Test Checklists and Report Forms: CxA shall submit sample checklists and forms to Contractor quality-control manager and subcontractors for review and comment. Submit two copies of each checklist and report form.

D. Certificates of Readiness: CxA shall submit Certificates of Readiness.

E. Test and Inspection Reports: CxA shall submit test and inspection

reports.

F. Corrective Action Documents: CxA shall submit corrective action documents.

G. Prefinal Commissioning Report Submittal: CxA shall submit two hard copies of the prefinal commissioning report. Include a copy of the preliminary submittal review comments along with CxA's response to each item. CxA shall deliver one copy to Owner and one copy to Architect. One copy, with review comments, will be returned to the CxA for preparation of final submittal.

H. Final Commissioning Report Submittal: CxA shall submit two hard copies and two sets of electronically formatted information of the final commissioning report. CxA shall deliver one hard copy and one set of discs to Owner, and one copy to Architect. The final submittal must address previous review comments and shall include a copy of the prefinal submittal review comments along with a response to each item.

1.10 QUALITY ASSURANCE

A. Instructor Qualifications: Factory-authorized service representatives, experienced in training, operation, and maintenance procedures for installed systems, subsystems, and equipment.

B. Test Equipment Calibration: Comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately whenever instruments have been repaired following damage or dropping. Affix calibration tags to test instruments. Instruments shall have been calibrated within six months prior to use.

1.11 COORDINATION

A. Coordinating Meetings: CxA shall conduct as needed coordination meetings of the commissioning team to review progress on the commissioning plan, to discuss scheduling conflicts, and to discuss upcoming commissioning process activities.

B. Pretesting Meetings: CxA shall conduct pretest meetings of the commissioning team to review startup reports, pretest inspection results, testing procedures, testing personnel and instrumentation requirements, and manufacturers' authorized service representative services for each system, subsystem, equipment, and component to be tested.

C. Testing Coordination: CxA shall coordinate sequence of testing activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

D. Manufacturers' Field Services: CxA shall coordinate services of manufacturers' field services.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 TESTING - LIGHTING AND PLUMBING FIXTURES

A. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.

B. Perform tests using design conditions whenever possible. (Lighting controls)

1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

2. Alter set points when simulating conditions is not practical and when written approval is received from CxA.

3. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.

C. Scope of Contractor Testing:

1. Testing scope shall include entire lighting installation and plumbing fixtures. It shall include measuring effectiveness of operational and control functions.

2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. Detailed Testing Procedures: CxA, with Contractor, shall prepare detailed testing plans, procedures, and checklists for lighting systems, subsystems, and plumbing fixtures.

1. Testing Plan shall include the following:

a. Sequence of testing and testing procedures for each item of equipment identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.

b. Tracking checklist for managing and ensuring that all sections have been tested.

E. Deferred Testing:

1. If tests cannot be completed because of a deficiency outside the scope of the Lighting or plumbing systems, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.

2. If the testing plan indicates specific seasonal testing,

appropriate initial performance tests shall be completed and documented and additional tests scheduled.

F. Testing Reports:

1. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.

2. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its readout, the reading at the controller's sensor(s), plus comments. Provide space for testing personnel to sign off on each data sheet.

3. Prepare a preliminary test report. Deficiencies will be evaluated by Architect to determine corrective action. Deficiencies shall be corrected and test repeated.

4. If it is determined that the system is constructed according to the Contract Documents, Owner will decide whether modifications required to bring the performance of the system to the OPR and BoD documents shall be implemented or if tests will be accepted as submitted. If corrective Work is performed, Owner will decide if tests shall be repeated and a revised report submitted.

3.2 OPERATION AND MAINTENANCE TRAINING REQUIREMENTS

A. Training Preparation Conference: Before operation and maintenance training, Contractor shall convene a training preparation conference to include Owner's operation and maintenance personnel, and subcontractors. In addition to requirements specified in Division 1 Section "Demonstration and Training," perform the following:

1. Review the OPR and BoD.

2. Review installed systems, subsystems, and equipment.

3. Review instructor qualifications.

4. Review instructional methods and procedures.

5. Review training module outlines and contents.

6. Review course materials (including operation and maintenance manuals).

7. Inspect and discuss locations and other facilities required for instruction.

8. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.

9. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

B. Training Modules: Develop an instruction program that includes

individual training modules for each system, subsystem, and equipment as specified in Division 1 Section "Demonstration and Training."

-- End of Section --

SECTION 01815

HVAC COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. OPR, BoD, and BoD-HVAC documentation prepared by Owner and Architect contains requirements that apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for commissioning the HVAC system and its subsystems and equipment. This Section supplements the general requirements specified in Division 1 Section "General Commissioning Requirements."

B. Related Sections include the following:

1. Division 1 Section "General Commissioning Requirements" for general requirements for commissioning processes that apply to this Section.

1.3 DEFINITIONS

A. Architect: Includes Architect identified in the Contract for Construction between Owner and Contractor, plus consultant/design professionals responsible for design of HVAC, electrical, communications, controls for HVAC systems, and other related systems.

B. BoD: Basis of Design.

C. BoD-HVAC: HVAC systems basis of design.

D. CxA: Commissioning Authority.

E. OPR: Owner's Project Requirements.

F. Systems, Subsystems, and Equipment: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, and equipment.

G. TAB: Testing, Adjusting, and Balancing.

1.4 CONTRACTOR'S RESPONSIBILITIES

A. The following responsibilities are in addition to those specified in Division 1 Section "General Commissioning Requirements."

B. Contractor:

1. Attend procedures meeting for TAB Work.

2. Certify that TAB Work is complete.

C. Mechanical Contractor:

1. Attend TAB verification testing.

2. Provide measuring instruments and logging devices to record test data, and data acquisition equipment to record data for the complete range of testing for the required test period.

D. HVAC Instrumentation and Control Contractor: With the CxA, review control designs for compliance with the OPR and BoD, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions.

E. TAB Contractor:

1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.

a. Verify the following:

1) Accessibility of equipment and components required for TAB Work.

2) Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.

3) Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.

4) Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.

5) Air and water flow rates have been specified and compared to central equipment output capacities.

b. Identify discontinuities and omissions in the Contract Documents.

c. This review of the Contract Documents by the TAB Subcontractor satisfies requirements for a design review report as specified in Division 15 Section "Testing, Adjusting, and Balancing."

2. Additional Responsibilities: Participate in tests specified in Division 15 Sections "HVAC Instrumentation and Controls" and "Sequence of Operation."

F. Electrical Contractor:

1. With the Mechanical Contractor, coordinate installations and connections between and among electrical and HVAC systems, subsystems, and equipment.

2. Attend TAB verification testing.

1.5 COMMISSIONING DOCUMENTATION

A. The following are in addition to documentation specified in Division 1 Section "General Commissioning Requirements."

B. BoD HVAC: Owner will provide BoD-HVAC documents, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

C. Test Checklists: CxA shall develop test checklists for HVAC systems, subsystems, and equipment, including interfaces and interlocks with other systems. CxA shall prepare separate checklists for each mode of operation and provide space to indicate whether the mode under test responded as required. In addition to the requirements specified in Division 1 Section "General Commissioning Requirements," checklists shall include, but not be limited to, the following:

1. Calibration of sensors and sensor function.

2. Testing conditions under which test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of test.

3. Control sequences for HVAC systems.

4. Strength of control signal for each set point at specified conditions.

5. Responses to control signals at specified conditions.

6. Sequence of response(s) to control signals at specified conditions.

7. Electrical demand or power input at specified conditions.

8. Expected performance of systems, subsystems, and equipment at each step of test.

9. Narrative description of observed performance of systems, subsystems, and equipment. Notation to indicate whether the observed performance at each step meets the expected results.

10. Interaction of auxiliary equipment.

11. Issues log.

1.6 SUBMITTALS

A. The following submittals are in addition to those specified in Division 1 Section "General Commissioning Requirements."

B. Testing Procedures: CxA shall submit detailed testing plan, procedures, and checklists for each series of tests. Submittals shall include samples of data reporting sheets that will be part of the reports.

C. Certificate of Readiness: CxA shall compile certificates of readiness from Contractor certifying that systems, subsystems, equipment, and

associated controls are ready for testing.

D. Certificate of Completion of Installation, Prestart, and Startup: CxA shall certify that installation, prestart, and startup activities have been completed. Certification shall include completed checklists provided by TAB Contractor as specified in Division 15 Section "Testing, Adjusting, and Balancing."

E. Test and Inspection Reports: CxA shall compile and submit test and inspection reports and certificates, and shall include them in commissioning report.

F. Corrective Action Documents: CxA shall submit corrective action documents.

G. Certified TAB Reports: CxA shall submit verified, certified TAB reports.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 TESTING PREPARATION

A. Prerequisites for Testing:

1. Certify that HVAC systems, subsystems, and equipment have been completed, calibrated, and started; are operating according to the OPR, BoD, and Contract Documents; and that Certificates of Readiness are signed and submitted.

2. Certify that HVAC instrumentation and control systems have been completed and calibrated; are operating according to the OPR, BoD, and Contract Documents; and that pretest set points have been recorded.

3. Certify that TAB procedures have been completed, and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

4. Test systems and intersystem performance after approval of test checklists for systems, subsystems, and equipment.

5. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

6. Verify each operating cycle after it has been running for a specified period and is operating in a steady-state condition.

7. Inspect and verify the position of each device and interlock identified on checklists. Sign off each item as acceptable, or failed. Repeat this test for each operating cycle that applies to system being tested.

8. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

9. Annotate checklist or data sheet when a deficiency is observed.

10. Verify equipment interface with monitoring and control system and TAB criteria; include the following:

a. Supply and return flow rates for ground source heatpump systems in each operational mode.

b. Operation of terminal heating in both heating and cooling cycles.

c. Minimum outdoor-air intake in each operational mode and at minimum and maximum airflows.

d. Building pressurization.

e. Total exhaust airflow and total outdoor-air intake.

f. Operation of indoor-air-quality monitoring systems.

11. Verify proper responses of monitoring and control system controllers and sensors to include the following:

a. For each controller or sensor, record the indicated monitoring and control system reading and the test instrument reading. If initial test indicates that the test reading is outside of the control range of the installed device, check calibration of the installed device and adjust as required. Retest malfunctioning devices and record results on checklist or data sheet.

b. Report deficiencies and prepare an issues log entry.

12. Verify that HVAC equipment field quality-control testing has been completed and approved. CxA shall direct, witness, and document field quality-control tests, inspections, and startup specified in individual Division 15 Sections.

B. Testing Instrumentation: Install measuring instruments and logging devices to record test data for the required test period. Instrumentation shall monitor and record full range of operating conditions and shall allow for calculation of total capacity of system for each mode of operation. For individual room cooling tests, provide temporary heaters to impose a cooling load indicated in BoD. Operational modes include the following:

1. Occupied and unoccupied.

2. Warm up and cool down.

3. Economizer cycle.

4. Emergency power supply.

5. Life-safety and safety systems.

6. Fire safety.

7. Temporary upset of system operation.

3.2 TAB VERIFICATION

A. TAB Contractor shall coordinate with CxA for work required in Division 15 Section "Testing, Adjusting, and Balancing." TAB Contractor shall copy CxA with required reports, sample forms, checklists, and certificates.

B. Contractor, HVAC Contractor, and CxA shall witness TAB Work.

C. TAB Preparation:

1. TAB Contractor shall provide CxA with data required for "Pre-Field TAB Engineering Reports" specified in Division 15 Section "Testing, Adjusting, and Balancing."

a. CxA shall use this data to certify that prestart and startup activities have been completed for systems, subsystems, and equipment installation.

D. Ductwork Air Leakage Testing:

1. Ductwork air leakage testing shall be performed according to Division 15 Sections and shall be witnessed by the CxA.

2. On approval of preliminary ductwork air leakage testing report, the CxA shall coordinate verification testing of ductwork air leakage testing. Verification testing shall include random retests of portions of duct section tests, reported in preliminary ductwork air leakage testing report. The HVAC Contractor shall perform tests using the same instrumentation (by model and serial number) as for original testing; the CxA shall witness verification testing.

E. Verification of Final TAB Report:

1. CxA shall select, at random, 10 percent of report for field verification.

2. CxA shall notify TAB Contractor 14 days in advance of the date of field verification; however, notice shall not include data points to be verified. The TAB Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.

3. Failure of an item is defined as follows:

a. For all readings other than sound, a deviation of more than 10 percent.

1) For sound pressure readings, a deviation of 3 dB. (Note: Variations in background noise must be considered.)

4. Failure of more than 10 percent of selected items shall result in rejection of final TAB report.

F. If deficiencies are identified during verification testing, CxA shall notify the HVAC Contractor and Architect, and shall take action to remedy the deficiency. Architect shall review final tabulated checklists and data sheets to determine if verification is complete and that system is operating according to the Contract Documents.

G. CxA shall certify that TAB Work has been successfully completed.

3.3 TESTING

A. Test systems and intersystem performance after test checklists for systems, subsystems, and equipment have been approved.

B. Perform tests using design conditions whenever possible.

1. Simulate conditions by imposing an artificial load when it is not practical to test under design conditions and when written approval for simulated conditions is received from CxA. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

2. Alter set points when simulating conditions is not practical and when written approval is received from CxA.

3. Alter sensor values with a signal generator when design or simulating conditions and altering set points are not practical. Do not use sensor to act as signal generator to simulate conditions or override values.

C. Scope of HVAC Contractor Testing:

1. Testing scope shall include entire HVAC installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. It shall include measuring capacities and effectiveness of operational and control functions.

2. Test all operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. Detailed Testing Procedures: CxA, with HVAC Contractor, TAB Contractor, and HVAC Instrumentation and Control Contractor, shall prepare detailed testing plans, procedures, and checklists for HVAC systems, subsystems, and equipment.

E. HVAC Instrumentation and Control System Testing:

1. Field testing plans and testing requirements are specified in Division 15 Sections "HVAC Instrumentation and Controls" and "Sequence of Operation." The CxA, HVAC Contractor, and the HVAC Instrumentation and Control Contractor shall collaborate to prepare testing plans.

2. CxA shall convene a meeting of appropriate entities to review test report of HVAC instrumentation and control systems.

F. Refrigeration System Testing: HVAC Contractor shall prepare a testing plan to verify performance of heat pumps systems. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment and section of pipe to be tested, identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment and pipe test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in

the system testing plan.

2. Tracking checklist for managing and ensuring that all pipe sections have been tested.

G. HVAC Distribution System Testing: HVAC Contractor shall prepare a testing plan to verify performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems. Include HVAC terminal equipment and unitary equipment. Plan shall include the following:

1. Sequence of testing and testing procedures for each item of equipment identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.

2. Tracking checklist for managing and ensuring that all sections have been tested.

H. Vibration and Sound Tests: HVAC Contractor shall prepare testing plans to verify performance of vibration isolation and seismic controls. CxA shall witness and certify tests and inspections.

I. HVAC Cooling/Heating System Components Testing: HVAC Contractor shall prepare a testing plan to verify performance of heat pump and heat recovery systems including the following Components:

1. Ground Source Heat Pump (GSHP-1,-2,-3, and -4) - The facility will be heated and cooled by a four single zone, up-flow ground source heat pumps. The entering water operating range for these heat pumps will be 85°F - 45°F. A sensor and/or thermostat will provide space temperature feedback and set point adjustment for each GSHP and will be located in the most appropriate location within the units control zone. Two VFD driven pumps (one in stand-by) will provide the circulation of loop water through the building and well field.

2. Geothermal Well Field - The building's HVAC systems will rely upon approximately 42+ geothermal wells to provide an adequate source of heat transfer from the refrigerant circuits of the individual heat pumps. The wells will be closed loop and use vertical bores to an approximate depth of 250. Water will circulate between the well field and the heat pumps via two base mounted centrifugal pumps. The heat pumps, loop pumps, and control valves will be located in the mechanical room. Valve boxes will be located outside to allow access to each well grouping. This will provide a point of access for maintenance and emergency shutoff.

3. Outside air (ERU-1) - The code required outside air will be ducted directly from the intake chimney to the O.A. connection on the energy recover unit. This required outside air will be pre-treated by the total energy wheel and then further conditioned by a GSHP coil. This preconditioned outside air will be ducted directly from the ERU to each GSHP. Exhaust air from the toilets will be ducted from each space back to the ERU and then discarded from the building via a second, exhaust only, and chimney.

4. Supplemental Heat (EDH-1 and 2) - Entryways will have an electric heaters installed to provide a supplemental heat as the doors to the

facility are used on extreme cold conditions.

5. General Building Exhaust - The building will be exhausted via the restrooms and support spaces by the energy recovery unit. The toilets will be kept at a (-) pressure with respect to the main lobby and vending areas. NOTE: The building will be kept at an overall (+) pressure with respect to the outside for odor and temperature control.

6. Testing Plan shall include the following:

a. Sequence of testing and testing procedures for each item of equipment identified by identification marker. Markers shall be keyed to Drawings showing the physical location of each item of equipment test section. Drawings shall be formatted to allow each item of equipment and section of piping to be physically located and identified when referred to in the system testing plan.

b. Tracking checklist for managing and ensuring that all sections have been tested.

J. Deferred Testing:

1. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, the deficiency shall be documented and reported to Owner. Deficiencies shall be resolved and corrected by appropriate parties and test rescheduled.

2. If the testing plan indicates specific seasonal testing, appropriate initial performance tests shall be completed and documented and additional tests scheduled.

K. Testing Reports:

1. Reports shall include measured data, data sheets, and a comprehensive summary describing the operation of systems at the time of testing.

2. Include data sheets for each controller to verify proper operation of the control system, the system it serves, the service it provides, and its location. For each controller, provide space for recording its readout, the reading at the controller's sensor(s), plus comments. Provide space for testing personnel to sign off on each data sheet.

3. Prepare a preliminary test report. Deficiencies will be evaluated by Architect to determine corrective action. Deficiencies shall be corrected and test repeated.

4. If it is determined that the system is constructed according to the Contract Documents, Owner will decide whether modifications required to bring the performance of the system to the OPR and BoD documents shall be implemented or if tests will be accepted as submitted. If corrective Work is performed, Owner will decide if tests shall be repeated and a revised report submitted.

-- End of Section --

SECTION 01820

DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training videotapes.

B. Related Sections include the following:

1. Division 1 Section "Allowances" for administrative and procedural requirements for demonstration and training allowances.
2. Division 1 Section "Project Management and Coordination" for requirements for preinstruction conferences.
3. Divisions 2 through 16 Sections for specific requirements for demonstration and training for products in those Sections.

C. Allowances: Furnish demonstration and training instruction time under the Demonstration and Training Allowance as specified in Division 1 Section "Allowances."

D. Unit Price for Instruction Time: Length of instruction time will be measured by actual time spent performing demonstration and training in required location. No payment will be made for time spent assembling educational materials, setting up, or cleaning up.

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

A. Instruction Program: Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. At completion of training, submit one complete training manual(s) for Owner's use.

B. Qualification Data: For instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.3 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Photographer Qualifications: A professional photographer who is experienced photographing construction projects.

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.4 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, and as follows:

1. HVAC systems, including air-handling equipment air distribution systems and terminal equipment and devices.
2. HVAC instrumentation and controls.
3. Lighting equipment and controls.
4. Plumbing fixtures

B. Training Modules: Develop a learning objective and teaching outline

for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.

2. Documentation: Review the following items in detail:

   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project Record Documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.
   m. Special operating instructions and procedures.

5. Adjustments: Include the following:

   a. Alignments.

b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

PART 3 EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Owner will furnish an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at

start of each season.

1. Schedule training with Owner, with at least seven days' advance notice.

D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a written demonstration performance-based test.

E. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

-- End of Section --

SECTION 02100

VDOT
SPECIFICATIONS FOR
ASBESTOS REMOVAL IN OCCUPIED BUILDINGS
NEW KENT REST AREA COMPLEX

PART 1 - GENERAL

1. Description of Work:

A. The contractor shall furnish all labor, materials, supplies and equipment necessary to remove and properly dispose of all asbestos-containing material (ACM) and/or contaminated material from:

1. **Storage #1 – 4275336:**

   a. Remove approximately 45 linear feet of asbestos-containing roof sealant from the roof system of this facility.

2. **Pump and Well House #1 – 4275358:**

   a. Remove approximately 25 linear feet of asbestos-containing door caulking from the interior of the door jam on this facility.

3. **Sewerage Treatment Building – 4275363:**

   a. Remove approximately 75 linear feet of asbestos-containing roof sealant from the roof system of this facility.

Note 1: All amounts are estimates. It is the contractor's responsibility to ascertain the exact amount of material to be removed and to base their bid on that amount.

B. This work may require the removal of existing flashing and miscellaneous trim in order to remove any and all whole or partial pieces of asbestos containing materials.

C. All work shall be performed in full compliance with all applicable EPA, OSHA and NIOSH regulations, all other applicable Federal, State and local government regulation and the specification contained herein. Where a conflict exists between these regulations and the project specifications, the most stringent shall apply. It is the intent of these specifications to apply requirements over and above those minimum requirements of the listed regulations.

D. Asbestos abatement contractors are not eligible to bid on those particular projects for which the asbestos inspection, bulk sample analyses or project designs were performed by individuals or firms employed by or financially affiliated with the contractors during the time period in which the inspections were conducted, samples analyzed or the project design written.

E. Asbestos project inspectors (project monitors) are not eligible to contract for project inspection work if they are financially affiliated with or employed by the asbestos abatement contractor on the project. These services are to be directly contracted for by the agencies and the monitoring personnel shall be accountable only to the Commonwealth officials.

F. All laboratories utilized for asbestos sampling analyses for project purposes shall have no direct business or financial relationship with the contractors conducting the asbestos abatement activities.

2. Definitions

A. ABATEMENT: Procedures to control fiber release from asbestos containing building materials. Includes securing the work area, removing the material, and cleaning the area and disposal of the material.

B. ABATEMENT CONTRACTOR: The company or individual properly licensed in the Commonwealth of Virginia by the Virginia Department of Professional and Occupational Regulations who conducted asbestos abatement activities such as, but not limited to, removal, encapsulation or enclosure of asbestos-containing materials.

C. ACM: Asbestos-containing material(s).

D. AGGRESSIVE SAMPLING: High-activity level air sampling which results in all settled asbestos remaining airborne and uniformly distributed through the use of special entrapment and mixing techniques. This makes any settled ash fibers accessible to the sampling fibers for subsequent detection.

E. AIRBORNE ASBESTOS FIBERS: Suspended, settling or moving asbestos fibers or fiber bundles in air.

F. AIR LOCK: A system for permitting ingress and egress with minimum air movement between a contaminated area and an uncontaminated area,

consisting of two curtained doorways separated by a dead air space of four feet.

G. AIR MONITORING: The process of measuring the fiber content of a specific volume of air in a stated period of time.

H. AMBIENT AIR: Air in an area outside of the asbestos containment area. Areas chosen for air sampling should not be located near access/egress routes for the project, nor should they be located in areas known to contain friable asbestos-containing materials.

I. AMBIENT SAMPLING: Air sampling of an area performed under normal or "as found" activity conditions.

J. AMENDED WATER: Water containing a wetting agent or surfactant.

K. AIHA: American Industrial Hygiene Association.

L. ANSI: American National Standards Institute.

M. ASBESTOS: The term asbestos includes Chrysotile, Amosite, Crocidolite, Tremolite, Anthrophyllite and Actinolite, and any of these minerals that has been chemically treated and/or altered.

N. ASBESTOS ANALYTICAL LABORATORY: A laboratory accredited by the National Institute of Standards and Technology (NIST) for transmission electron microscopy (TEM) analysis, and licensed by the Virginia Department of Professional and Occupational Regulation to perform phase contrast microscopy (PCM) or TEM on material known or suspected to contain asbestos.

O. ASBESTOS-CONTAINING MATERIAL (ACM): The material or product containing more than 1.0-% asbestos by volume.

P. ASBESTOS CONTAINMENT AREA: An area where an asbestos response action takes place.

Q. ASBESTOS DEBRIS: Pieces of ACM that can be identified by color, texture, or composition, or particulate matter (i.e. dust) if determined by an accredited inspector to contain more than 1.0% asbestos by volume.

R. ASBESTOS REGULATED AREA: An area where asbestos removal operations and some support activities are performed. This area is isolated by physical barrier labeled with warning signs and includes

regions where the airborne concentration of asbestos exceeds or can be reasonably expected to exceed the permissible exposure limit.

S. AREA MONITORING: Sampling of asbestos fiber concentrations within the asbestos regulated area. Sampling strategy must be designed to yield fiber counts representative of airborne fiber levels in the breathing zone.

T. AUTHORIZED PERSON OR VISITOR: The building Owners, or their authorized representative, or any representative of a regulatory, or other agency having jurisdiction over the project.

U. CLEAN ROOM: An uncontaminated room having facilities for the storage of employees' street clothing and uncontaminated materials and equipment.

V. CURTAINED ACCESS-WAY: a device to allow ingress and egress from one room to another while permitting minimal air movement between the rooms, typically constructed by placing two overlapping sheets of plastic over an existing or temporarily framed access-way, securing each along the top of the doorway, securing the vertical edge of one sheet along one vertical side of the doorway and securing the vertical edge of the other sheet along the opposite vertical side of the doorway.

W. DECONTAMINATION FACILITY: An enclosed area adjacent and connected to the regulated area and consisting of an equipment room shower area and clean room which is used for the decontamination of workers, materials and equipment contained with asbestos.

X. DOT: Department of Transportation.

Y. ENCAPSULATION: The treatment of ACM with a material that surrounds or embeds asbestos fibers in an adhesive matrix to prevent the release of fibers, as the encapsulant creates a membrane over the surface (bridging encapsulant) or penetrates the material and binds its components together (penetrating encapsulant).

Z. ENCLOSURE: An airtight, impermeable, permanent barrier around ACM to prevent the release of asbestos fibers into the air.

a. EQUIPMENT ROOM (CHANGE ROOM): A contaminated room located within the decontaminated area that is supplied with impermeable bags or containers for the disposal of contaminated protective clothing and equipment.

b. FIXED OBJECT: A unit of equipment of furniture in the work area which cannot be removed from the work area.

c. FRIABLE ASBESTOS MATERIAL: Material which is capable of being crumbled, pulverized or reduced to powder by hand pressure or which under normal use or maintenance emits or can be expected to emit asbestos fibers into the air.

d. GLOVEBAG TECHNIQUE (to be used following all OSHA and EPA rules and regulations): A method with limited applications for removing small amounts of friable asbestos-containing materials from HVAC ducts, short piping runs, valves, joints, elbows, and other nonplanar surfaces in a non-contained work area. The glovebag assembly is a manufactured or fabricated device consisting of glovebag (typically constructed of 6-mil transparent plastic), two inward projecting long sleeve rubber gloves, one inward projecting waterwand sleeve, an internal tool pouch and an attached labeled receptacle for asbestos waste. The glovebag is constructed and installed in such a manner that it surrounds the object or area to be decontaminated and contain all asbestos fibers released during the removal process. All workers who are permitted to use the glovebag technique must be highly trained, experienced, and skilled in this method. Glovebags must be under negative air pressure during use.

e. HEPA FILTER EQUIPMENT: High efficiency particulate air filtered vacuuming equipment with a filter system capable of collecting and retaining asbestos fibers. Filters shall be 99.97 percent efficient for retaining particles and fibers with a minimum dimension of 0.3 micrometers.

f. LOGBOOK: A notebook or other book containing essential data and daily project information and a daily project diary. This book is kept on the project site at all times.

g. MINI-ENCLOSURE: A method with limited applications for removing small amounts of friable asbestos-containing materials typical for small scale short duration type projects.

h. MOVABLE OBJECTS: A unit of equipment of furniture in the work area which can be removed from the work area.

i. NEGATIVE AIR PRESSURE EQUIPMENT: A portable local exhaust system equipped with HEPA filtration and capable of maintaining a constant, low velocity air flow into the contaminated area from adjacent uncontaminated areas.

j. NIOSH: National Institute for Occupational Safety and Health.

k. OSHA: United States Occupational Safety and Health Administration and the Virginia Occupational Safety and Health Division of the Department of Labor and Industry.

l. OWNER: Virginia Department of Transportation

m. PAT PROGRAM: Proficiency Analytical Testing.

n. PERMISSIBLE EXPOSURE LIMIT (PEL): The contractor shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 0.1 fibers per cubic centimeter of air as an eight (8) hour time-weighted average (TWA) as determined by the method described in 29 CFR 1926.1101, Appendix A.

o. PERSONAL MONITORING: Sampling of asbestos fiber concentration within the breathing zone of an employee (i.e. attached to or near the collar or lapel near the worker's face).

p. PHASE CONTRAST MICROSCOPY (PCM): A laboratory analysis method for measuring airborne asbestos fibers (National Institute of Occupational Safety and Health Method 7400).

q. PROJECT MONITOR: A person who is licensed by the Virginia Department of Professional and Occupational Regulation to observe and monitor the activities of asbestos abatement contractors and roofing, flooring, siding (RFS) contractors on asbestos projects to determine that proper work practices are used and compliance with all federal, state and local laws and regulations are maintained.

r. REMOVAL: All herein specified procedures necessary to remove asbestos-containing materials from the designated areas and to dispose of these materials at an acceptable site.

s. REOCCUPANCY (CLEARANCE) LEVEL: .01 or fewer asbestos fibers per cubic centimeter (.01 f/cc) of air if determined by PCM, or 70 or fewer asbestos structures per square millimeter (70 S/mm2) if determined by TEM analysis.

t. RESPONSE ACTION: A method, including removal, encapsulation, enclosure, repair, operations and maintenance, to abate asbestos hazards to human health and the environment.

u. SHOWER ROOM: A room between the clean room, and the equipment room in the worker decontamination unit with hot and cold or warm running water and suitably arranged for complete showering during decontamination. The shower room comprises an air lock between the contaminated and clean area. Shower water filtration system shall be used to remove asbestos fibers from waste water.

v. SURFACTANT: A chemical wetting agent added to water to improve penetration.

w. TIME WEIGHTED AVERAGE (TWA): Representative samples are required to establish the eight- (8) hour time weighted average. The TWA is an eight (8) hour time weighted average airborne concentration of fibers, as determined according to 29 CFR 1926.1101, Appendix A. Work-shifts which differ from an eight (8) hour duration may require adjustments of the standard which applies.

x. TRANSMISSION ELECTRON MICROSCOPY (TEM): A laboratory analysis method of measuring airborne asbestos fibers using a transmission electron microscope (40 CFR Part 763, Appendix A to Subpart E).

y. USEPA: United States Environmental Protection Agency.

z. WASHROOM: A room between the work area and the holding area in the equipment decontamination area. The washroom comprises an air lock.

aa. WET CLEANING: The process of eliminating asbestos-contamination from building surfaces and objects by using cloths mops, or other cleaning tools which have been dampened with water, and by afterwards disposing of these tools as asbestos-contaminated waste.

bb. WORK AREA: Designated rooms, spaces or areas of the project in which asbestos abatement actions are to be undertaken or which may become contaminated as a result of abatement actions. A contained work area is a work area which has been sealed, plasticized and equipped with a decontamination enclosure system. A non-contained work area is an isolated or controlled-access work area which has not been plasticized nor equipped with a decontamination enclosure system.

PART II - GENERAL WORK PRACTICE

1. Regulations

A. The contractor shall comply with all EPA and OSHA Regulations, and shall follow EPA workplace guidelines unless they are shown not to be applicable. Pertinent OSHA standards are the applicable sections of 29 CFR 1910 and 29 CFR 1926 including, but not limited to, 1910.1001, 1910.134 and 1926.1101. EPA workplace guidelines include those pertinent sections of Part I and II, EPA guideline document 560/5-85-024,"Guidance for Controlling Asbestos Containing Materials in Buildings", and to include but not limited to EPA regulations 40 CFR Part 61 Subparts A and B. Also include all documents incorporated by reference herein.

B. The contractor shall remove, transport and dispose of the asbestos from the job site in compliance with 40 CFR, Part 61.25 of the EPA regulation, the Virginia Department of Environmental Quality Regulations and these specifications. The contractor shall be responsible for obtaining the approval document for a waste disposal site in compliance with 40 CFR, Part 61.25 of the EPA regulations and other governing regulations.

C. The contractor shall be licensed in accordance with the provision of Chapter 7.01 (54-145 et seq.) of Title 54. Include copy of current, valid license with submittals.

2. Protection of Existing Work to Remain

A. Perform demolition and removal work without damage or contamination of adjacent work. Where such work is damaged or contaminated, it shall be restored to it's original condition at the contractor's expense. The contractor and the owner shall agree in writing on the condition of the building and fixtures prior to commencement of the work.

B. All materials resulting from demolition work, except as specified otherwise, shall become the property of the contractor and shall be disposed of as specified herein.

3. Notification

A. Make required notifications at least twenty days prior to beginning removal of asbestos-containing materials.

Notifications should be addressed to:

DLI Asbestos Control Clerk
13 South Thirteenth Street
Richmond, VA. 23219

Asbestos NESHAP's Coordinator
3AM22, Air Management Division
EPA Region III
341 Chestnut St.
Philadelphia, PA. 19107

B. If material to be removed is a Category I or Category II non-friable material, the 20-day notification need not be sent unless the material becomes friable during removal, at which time the contractor will stop work and make all notifications. Friability will be determined by the on-site project monitor.

4. Project Superintendent

A. The contractor shall have a "project superintendent" present at all times while work on this contract is in progress. The project superintendent shall be thoroughly familiar and experienced with asbestos removal and related work and shall enforce the use of all safety procedures and equipment. He shall be knowledgeable of all EPA, OSHA and NIOSH requirements and guidelines.

B. The superintendent shall have a current, valid asbestos supervisor's license issued by the Virginia Department of Professional and Occupational Regulation in accordance with the provisions of Chapter 7.01 (54-145.4 et seq.) of Title 54.

PART III - SUBMITTALS

The following items (two copies each) shall be submitted and approved by the owner with the exception being the landfill manifest receipt, logs and air monitoring results prior to commencing any work.

1. Asbestos Plan:

A. Submit a detailed plan of the work procedures to be used in the removal of the materials containing asbestos. Such plans shall include the location of the asbestos work areas, change rooms, layout of change rooms, interface with other trades involved in this project, sequencing of asbestos related work, disposal plan, type of wetting agent, asbestos sealer, air monitoring and detailed description of the methods to be employed in

order to control air pollution. This plan must be approved by the owner's representative prior to the start of any asbestos work. Should the contractor subsequently desire to vary from this plan, he shall submit a written request to do so.

2. Notification:

   A. Submit a copy of the required notification submitted to the Asbestos Control Clerk, Department of Labor and Industry.

3. Testing Laboratory

   A. Submit the name, address, and telephone number of the testing laboratory selected for the monitoring of airborne concentrations of asbestos fibers along with a copy of the Commonwealth of Virginia Asbestos Analytical Laboratory License. Also include evidence that the laboratory is accredited to analyze airborne asbestos fibers counts.

4. Monitoring Results:

   A. All monitoring results are to be received within 24 hours and retained at the work site where they may be reviewed by the Owner's representative. Submit copies of these results at the completion of the project.

5. Landfill:

   A. Submit written evidence (copy of permit) that the landfill for disposal is approved for disposal of friable asbestos materials by the USEPA and state or local regulatory agencies and where the landfill site is located. Within thirty-five days of the deposit of a load of waste from this project at the designated landfill; the contractor shall submit a copy of the waste system record to the Owner. The Owner shall have received all acceptable waste manifests prior to making any payments to the contractor.

6. Certificate of Compliance:

   A. A copy of the manufacturers certificate of compliance with ANSI 9.2 for each brand and model of vacuum, ventilation and other equipment used by the contractor to contain or remove asbestos fibers.

7. Qualification of the Contractor's Personnel and Personnel Training:

A. Prior approval by the owner is required of all proposed asbestos removal personnel. Approval shall be based on review and acceptance of contractor's written submittals that all of its personnel working in this asbestos project:

1. Have a current, valid asbestos worker's or supervisor's license issued by the Virginia Department of Professional and Occupational Regulation in accordance with the provisions of Chapter 7.01 (54-145.4 et seq.) of Title 54.

2. Have been provided with a respirator fit test in accordance with 29 CFR 1926.1101 at the time of the initial fitting, when facial conditions change, and at least every twelve months thereafter for each employee wearing a negative-pressure respirator.

3. Have been trained in the proper procedures to follow in the event of an emergency.

8. Medical Requirements:

A. Submit certification that contractor has an established medical surveillance program in compliance with OSHA regulations 29 CFR 1926.1101. This submittal shall include copies of the physician's statement that each employee (working on this project) is able to perform his duties while wearing a respirator.

9. Respirator Program:

A. Submit a copy of a written respirator program that complies with OSHA regulation 29 CFR 1910.134.

10. Logs:

A. Copies of daily progress log and visitor's log.

PART IV - PERSONNEL PROTECTION

1. Respirators:

A. Workers shall wear properly fitted respirators in the work area. Respirator selection shall be based on personal air monitoring as required by 29 CFR 1926.1101. Long sideburns, beards etc., which interfere with proper fit are unacceptable.

B. All work involving the removal of friable asbestos materials requires the use of Class "C' supplied air respirators unless respirators of lower protection factor are authorized by the Owner or his representative. Supplied air quality shall be C.G.A. grade D breathing air or better from a certified air source. Copies of these certificates will be supplied to the Owner or its representative.

C. Supplied air respirator systems must include a back-up provision approved for maintaining air flow long enough for escape and decontamination from a contaminate atmosphere in the event of loss of the primary source of breathing air.

2. Equipment:

A. All protective equipment requires the approval of the Owner. Workers shall wear disposable, full body coveralls, disposable head covers and disposable footwear in the work area. Required protective equipment also includes goggles if half-faced masks are used, and disposable gloves taped to the sleeves of the suit. If heavy reusable gloves are necessary, they shall be of a type approved by the Owner. Such gloves shall be rinsed at the end of each day. Prior to disposal, contaminated water shall be filtered to retain particles 1.0 microns or larger or disposed of as asbestos waste.

B. Make available to the owner's representative complete sets of personal protective equipment as required herein for entry to the asbestos control area at any time for inspection of the asbestos control area.

C. Air Handling Equipment: Equipment shall be high-efficiency particular air (HEPA) absolute filtration system, equipped with filtration equipment in compliance with ANSI 29.2. No air movement system or air equipment shall discharge asbestos fibers outside the work area.

3. Caution Signs and Labels

A. Provide caution signs at all approaches to the asbestos control areas containing concentrations of airborne asbestos fibers. Locate signs at such a distance that personnel may read the sign and take the necessary protective steps required before entering the area. Provide labels and affix to all asbestos materials, scraps, waste, debris and other products contaminated with asbestos.

1. Caution sign: Vertical format conforming to 29 CFR 1926.1101, Minimum 20 by 14 inches.

2. Caution Label: provide labels of sufficient size to be clearly legible conforming to requirements of 1926.1101.

4. Decontamination Area

A. The contractor shall set up a decontamination area including an equipment room, clean room, and a shower outside the work area. This areas shall include a clean room connected by a double barrier to a walk through shower which is also connected by a double barrier to an equipment room. Individual storage boxes or lockers shall be provided for each worker's street clothes. The equipment, clean room and shower areas shall be cleaned daily.

B. The clean room, shower, and equipment room must be sealed completely to ensure that the sole source of airflow through these areas originate from uncontaminated areas outside the asbestos removal, demolition, or renovation enclosure. The shower must be drained and filtered to retain particles 1.0 microns or larger, after each use to ensure that contaminated water is not released to uncontaminated areas. If waste is inadvertently released, it shall be cleaned up as soon as possible to prevent any asbestos in the water from drying and becoming airborne in areas outside the work area. The contractor will be responsible for the needed water source.

C. In all cases, access between contaminated and uncontaminated rooms or area shall be through an airlock.

PART V - WORK PROCEDURE

1. General:

A. Perform asbestos related work in accordance with 29 CFR 1926.1101 and as specified herein. Use wet removal procedures. All personnel shall wear and utilize protective clothing and equipment as specified herein. Eating, gum and tobacco chewing, smoking, or drinking shall not be permitted in the asbestos control area. Personnel of other trades not engaged in the demolition and removal of asbestos materials shall not be exposed at any time to airborne concentrations of asbestos.

B. Provide temporary power sources and equipment per applicable electrical code requirements and provide 24-volts safety lighting and ground-fault interrupter circuits as power sources for electrical equipment.

C. Turn off electricity to the work area other than that required in the previous paragraph.

2. Preparation of Work Areas:

External:

A. Establish an asbestos work control area on the ground with the use of asbestos barrier tape or other barricades placed such that an area of at least 50-ft. is created, if practicable. Asbestos control areas are also needed at perimeter area of the building and shall be outside of the control area at all times to allow access to the building by the Owner's employees. The ground in these asbestos control areas shall be covered with 1 layer of 6-mil plastic or an approved equivalent in a manner approved by the Owner or his Representative. This includes access areas to the roof and paved vehicle parking.

B. All openings to the interior portions of the building through which contamination could pass must be sealed with 6-mil poly prior to beginning any work which could release asbestos dust. This includes windows, doors and vents located inside the asbestos controlled areas. Interior portions of the roofing must also be sealed with 6-mil poly to prevent contaminated water from entering the facility.

C. The asbestos-containing roofing/siding materials shall be wrapped in a burlap type bag, or equivalent, then double wrapped in plastic (6 mil minimum) and labeled prior to being lowered to the work control area. The ACM must be lowered to the ground in the asbestos control work area by mechanical lifts or some other means which prevents the generation of dust. Wrapped materials will not be dropped to the ground in a free fall manner.

D. Any persons entering the asbestos control work area shall enter and exit through the decontamination area and follow all safety requirements of the project.

Internal:

A. Clean the proposed work areas using HEPA filtered vacuum equipment or wet cleaning methods as appropriate. Methods that raise dust, such as

dry sweeping or vacuuming with equipment not equipped with HEPA filters, shall not be used.

B. Seal off all openings before covering walls and ceilings, to include, but not limited to: corridors, access ways, skylights, ducts, grilles, diffusers, and any other penetrations of the work area, with one layer of 6 mil plastic sheeting sealed with tape. Access ways and corridors which will not be used for passage during work must be also sealed.

1) For enclosed areas where only asbestos containing floor tile/mastic will be removed:

a. Cover all wall surfaces with one layer of 6 mil plastic and sealed with tape at floor or baseboard levels and at least three feet up on the wall surface, thus creating a second layer over any penetrations previously sealed, thus creating a "splash guard" to protect wall coverings from mastic removal operations.

2) For enclosed areas where asbestos abatement work is on the ceiling surface:

a. Cover floor and wall surfaces with plastic sheeting sealed with tape. Use a minimum of two layers (three layers in carpeted areas of 6-mil plastic on floors and walls. Cover floors first so plastic extends at least 12 inches up the wall, then cover the walls with minimum of 6 mil plastic sheeting to the floor level, thus overlapping the floor materials by a minimum of 12 inches, then continuously tape edges to provide a complete seal.

b. Remove and clean ceiling-mounted objects, such as lights and other items not previously sealed off, that interferes with asbestos abatement. Use localized water spraying of HEPA filtered vacuum equipment during fixture removal to reduce fiber dispersal.

3) For work areas that require complete enclosure:

a. Cover floor, wall and ceiling surfaces with plastic sheeting sealed with tape. Use a minimum of two layers (three in carpeted areas) of 6 mil plastic on floor and walls. Cover floors first so that plastic extends at least 12 inches up on wall.

b. Cover entire ceiling surface with one layer (overlapping 12" at any seams) of 6 mil plastic sheeting extending 12" down walls and sealed with tape, thus creating a second layer over penetrations previously sealed.

c. Cover all wall surfaces with one layer (overlapping 12" at any seams) of 6 mil plastic and sealed with tape at ceiling and floor or baseboard levels, thus creating a second layer over penetrations previously sealed.

d. Maintain emergency and fire exits from the work area or establish alternative exits satisfactory to the applicable fire officials.

PART VI - ASBESTOS REMOVAL PROCEDURES

1. General Procedures:

A. The contractor is required to maintain at the job site a copy of the EPA, OSHA and applicable state and local government regulations regarding the handling of asbestos materials.

B. The asbestos control area, in an internal environment, shall be maintained under a negative pressure at all times.

2. Asbestos Handling Procedures:

A. Sufficiently wet asbestos material with a fine spray of amended water during removal, cutting or other handling as to reduce the emission of airborne fibers. No mechanical removal or cutting will be performed unless HEPA vacuumed. Wetting Agent (surfactant for amended water) is to be a solution of 50% polyoxyethylene ether and 50% polyexyethylene ether or equivalent and shall be mixed with water to provide a concentration of one source surfactant to 5 gallons of water. Remove material and immediately place in plastic disposable bags, 6-mil minimum. Submit any alternate proposal for containment of asbestos fibers to the Owner for approval.

B. After completion of stripping work, all surfaces from which asbestos has been removed or contaminated shall be wire brushed and/or wet sponged or cleaned by an equivalent method to remove all visible material. During this work, the surfaces being cleaned shall be kept wet.

1. Procedure for Removal of Asbestos Containing Floor Tile

a. Equipment and Supplies:

1. Airless sprayer
2. Amended water
3. Disposable clothing
4. Duct tape
5. Class "C" supplied air respirators are required unless respirators of a lower protection factor are authorized by the Owner or his representative
6. HEPA filter vacuum
7. 6 mil poly
8. Tools (i.e. razor, knife, scraper)
9. Wire brush
10. Encapsulant
11. Burlap-type bags or equivalent.

b. Preparation:

1. Put on disposable clothing.
2. Put on Class "C' supplied air respirators unless respirators of a lower protection factor is authorized by the Owner or his representative.
3. Mix amended water in a pump-up sprayer.

c. Removal Procedures - Removal of Floor Tile:

1. Wet the work site tile.
2. Contractor shall remove floor tile and mastic. Contractor shall not cut, grind, crush or similarly handle asbestos floor tile so that dust is emitted.

3. Clean tools.

4. Personal and area air samples will be taken during removal.

5. Place all removed floor tile in a burlap type bag, or equivalent, prior to placing material in two (2) 6 mil minimum properly labeled disposal bags.

d. Tile Removal Procedures - Final Cleanup:

1. Inspect area for visible dust - clean.

2. HEPA vac entire area.

3. Wet wipe entire area twice.

4. Properly dispose of plastic, coveralls, respirator, respirator filters, and other contaminated items.

5. Finish cleaning tools.

6. All contaminated materials must be disposed of at an approved landfill.

e. Clearance:

1. Final clearance shall be conducted by following the procedures found in Part VII of this specification.

f. The Armstrong Method:

1. The Armstrong Method of floor tile removal is acceptable for projects involving less than 250 sq. ft. of floor tile and/or mastic. All procedures and controls shall be included in the Abatement Plan submitted to the Owner for his review.

2. All of the requirements of Part VI, 2.B.1.c.2-5 shall be met.

2. <u>Procedure for Glovebag Removal of Asbestos-Containing Pipe Insulation</u>:

a. Glovebag asbestos removal may be employed for removing thermal system insulation where full area preparation is

impractical and where approved by the Engineer. Critical barriers and reduced air pressure are required for glovebagging and the following procedures shall be employed. Respiratory protection is required. Personal monitoring shall be conducted by the contractor during glovebag removal.

1. Glovebag Equipment and Supplies:

    a. Airless sprayer

    b. Amended water

    c. Disposable clothing

    d. Duct tape

    e. Class "C" supplied air respirators are required unless respirators of a lower protection factor are authorized by the Owner or his representative.

    f. HEPA filter vacuum

    g. 6 mil poly

    h. Glovebag

    i. Tools (i.e. razor, knife, wire cutters)

    j. Wire brush

    k. Encapsulant

    l. Air filtration equipment

2. Preparation:

    1. Seal off all openings, including but not limited to:

        a) All windows

        b) Corridors

        c) Doorways

d) Skylights

e) Ducts, grills

f) Diffusers

g) And any other penetrations of the work area with plastic sheeting (minimum of 6 mils thick) sealed with tape.

3. Fitting and Attachment to Pipe:

a. Slit glovebag sides to fit the size of the pipe.

b. Place tools, etc., in bag.

c. Attach glovebag to pipe by folding the open edges together and securely sealing with tape.

NOTE: Ensure adequate space for working behind the pipe.

d. Seal all openings in glovebag.

e. Seal glovebag bottom seam with duct tape.

f. Inspect glovebags for defects.

g. Slit bag for water sprayer and HEPA vac.

4. Glovebag Removal Procedures - Removal of Insulation:

NOTE: Glovebag removal should not be used if the use of the glovebag will cause fiber release from sections of the pipe that are not enclosed. If the pipe insulation is badly damaged, fully wrap and seal sections not being removed with poly and duct tape.

Glovebags are single use items, only, unless they have been designed and certified for multiple use.

a. Thoroughly wet the work site insulation.

b. Remove wire, bands or aluminum sheeting.

c. Cut insulation while wetting and place into bag.

d. Wet insulation ends, clean bare pipe of visible accumulation of ACM.

e. Clean pipe with wire brush and wet wipe with wetting agent until no trace of the asbestos containing material can be seen.

f. Apply encapsulant.

g. Seal exposed insulation ends.

h. Clean tools in bags.

i. Pull glove bag with tools inside out, seal glove from bag and cut off glove.

j. Insert HEPA vacuum into bag and remove air.

k. Twist and seal bag with duct tape or electric tie.

l. Remove HEPA vacuum.

m. Remove glovebag.

5. Clearance:

a. Acceptable removal will be achieved when all visible ACM has been removed inside of the glovebag containment and the removal area properly encapsulated.

The Owner's Representative will determine when acceptable cleaning has been achieved.

3. Procedure for Mini-Enclosures:

a. Mini-enclosures systems may be employed for small- scale, short duration asbestos removal where full area preparation is impractical and where approved by the Owner. Mini-enclosures shall be constructed around air filtration equipment and the bag loading area of vacuum equipment when these units are located outside the work area.

1. Preparation:

a. Erect a 6 mil poly enclosure supported in a frame of sufficient strength ("2x4" studs) to remain secure and airtight during abatement procedures.

b. Erect a two air lock decontamination chamber using 6-mil poly.

c. Reduced pressure within the work areas shall be maintained by air filtration equipment or a sufficient number of approved HEPA vacuums.

2. Asbestos Removal: Follow procedures given herein before, Part VI (2) - Asbestos Handling Procedures.

3. Clearance:

a. Acceptable removal will be achieved when either the requirements of Part VII - CLEARANCE AIR MONITORING have been met or a visual inspection has been conducted by the Owner's Representative and all visible ACM has been removed and the removal area properly encapsulated. The procedure to be utilized will be determined by the Owner or his Representative.

4. <u>Procedures for Contaminated Soil Removal:</u>

a. Removal of contaminated soils may be required when asbestos-containing materials (ACM) have become damaged and pieces of the ACM have fallen onto unprotected soil. Contamination shall be determined when pieces of ACM are visible as debris or when bulk sample analysis shows an asbestos fiber level greater than 1%.

1. Construct a decontamination enclosure as previously discussed in Part IV, Section 4. of this specification.

2. Seal all openings into the work area with at least one (1) layer of 6-mil minimum polyethylene sheeting.

3. Install negative air system using approved equipment unless the use of negative air system is not practicable.

Practicability shall be determined by the Owner or his Representative.

4. Lightly wet with a surfactant or diluted encapsulant any contaminated soil to be removed.

5. Remove contaminated debris and/or soil to a depth of 4" from the original surface or to hard pan and until all visible debris has been removed.

6. Remove all remaining ACM in the area in conjunction with the contaminated soil removal in a manner as not to recontaminate the cleaned areas.

7. Encapsulate the entire area with a latex sealer approved by the Owner or his Representative.

8. Cover the area with a single layer of 6-mil minimum polyethylene sheeting unless waived by the Owner or his Representative, in writing. The polyethylene sheeting shall be secured in a manner approved by the Owner or his Representative.

5. Procedures for Removal of Roofing or Siding Materials:

a. Prepare area as stated in Part V - Section 2. External.

b. Any mechanical equipment used to loosen or remove any asbestos-containing material must be equipped with a HEPA filtering system designed by the equipment manufacturer to be used with that particular piece of equipment.

c. All persons inside of the work control area shall wear proper respiratory protection and full body coverings. All persons who enter the control area shall shower after leaving the work control area. Street clothing shall not be worn inside of the work control area.

d. Clearance shall be considered acceptable when all visible ACM has been removed. The Owner's Representative will determine when all visible ACM has been removed. The area will then be completely and properly encapsulated.

3. Pre and Post Removal Inspection

A. The Owner will provide (at their own expense) a licensed Asbestos Project Monitor who will collect pre-abatement air samples and who must inspect and approve the work area preparations before authorizing the contractor to begin removal. The Asbestos Project Monitor must also inspect and approve removal and cleaning in the asbestos control area before the contractor may remove barricades. It is the responsibility of the Asbestos Contractor to give 20-day initial advance notice in writing and 72 hours thereafter to the VDOT Resident Engineer and District Engineer and the Asbestos Project Monitor prior to work being performed or a request for inspection. No removal of asbestos materials is to be conducted without the Project Monitor on-site. If, at the time, the work is not substantially complete, the contractor shall be held responsible for the cost of subsequent re-inspections.

4. Air Monitoring

A. The contractor shall provide personnel to air monitor as required by OSHA regulation 29 CFR 1926.1101. The contractor shall cooperate with the Owner's Representative for all testing and sampling.

B. The Owner's Representative shall inform the contractor of any area samples outside of the containment with results in excess of 0.01 fibers/cc. Operations shall be immediately discontinued until the violation is corrected.

C. All analytical results from the laboratory's monitoring shall be posted at the work site entrance no later than 24 hours after sampling and copies presented to the Owner signed "Certificates of Analysis". The form shall state:

(1) Date and time sampling began.

(2) Flow rate of samples.

(3) Sampling time elapsed.

(4) Concentration of fibers.

(5) Location of area where sample was taken (building, floor, room, area within room).

(6) Activity occurring during sampling (removal, clean up, clean-air, etc.).

(7) Name and phone number of person taking sample.

(8) Name, phone number, and signature of person analyzing sample.

(9) Name and phone number of contractor.

D. Exposure records: The contractor shall maintain records of any personnel or environmental monitoring required by this specification. Records shall be maintained for a period of at least 30 years and shall be made available upon request to the Secretary of Labor for Occupational Safety and Health, the Director of the National Institute for Occupational Safety and Health, and to authorized representatives of either.

E. Copies of all exposure records and area monitoring records shall be submitted to the Owner at the conclusion of the project.

5. Cleanup:

A. External:

1. Work area shall be clean of all construction debris and left in a neat and orderly condition.

B. Internal:

1. Remove visible accumulations of asbestos material and debris. Wet clean all surfaces within work area.

2. Remove the plastic sheets from walls and floors only. The windows and doors shall remain sealed and the HEPA-filtered negative air pressure systems, air filtration, and decontamination enclosure systems shall remain in service.

3. Clean all surfaces in the work area and any other contaminated areas with water and/or with HEPA-filtered vacuum equipment all surfaces in the work areas. After completion of the second operation, perform a complete visual inspection of the work area to ensure that the work area is free of visible asbestos debris.

4. Sealed drums and all equipment used in the work area shall be included in the cleanup and shall be removed from work areas, via the equipment decontamination enclosure system at an appropriate time in the cleaning sequence.

5. After the areas have successfully passed the visual inspection and prior to the removal of the last layer of plastic, apply one coat of an approved asbestos encapsulant sealer.

6. Remove the last layer of plastic sheeting from the walls and floor after the sealant has dried. The window, access way, vents, etc, shall remained sealed and the air filtration system off.

7. The work area is to have a 24-hour settling period; dust shall be allowed to settle without being disturbed during this period. A shorter period of time may be allowed on smaller projects with the approval of the Project Monitor.

8. After the settling period, wet clean or HEPA vacuum all surfaces within the work area. Once this cleaning operation is completed, visually inspect the area to ensure that it is free of contamination.

9. Clearance air samples will be taken by the "Owner's Representative" and must meet the clearance air sampling requirements found in Part VII of these specifications. Wall and floor poly shall have been removed but all exits and vents shall remain sealed. The negative air machines will remain operational until final clearance is certified.

6. Re-Establishment of Objects and Systems (if necessary)

A. After cleanup is completed, relocate objects moved to temporary location in the course of the work to their former positions and re-secure mounted objects removed in the course of the work to their former positions.

B. Advise Owner to reestablish mechanical and electrical systems in proper working order. Install new filters and dispose of used filters as contaminated waste.

C. Repair or replace objects damaged in the course of the work, as directed by the Owner's Representative.

7. Site Inspection

A. While performing asbestos removal work, the contractor shall be subject to onsite inspection by the Owner's representative who may be assisted by safety or health personnel. If the work is found to be in violation of this specification, the Owner's Representative will issue a stop work order to be in effect immediately. Until the violation is corrected, the standby time shall be at the contractor's expense.

8. Building Contamination

A. If is determined by exceeding emission limits on air samples and/or analysis of surface dust samples that building contamination had occurred as the result of negligence and/or poor work practices of the contractor, the contractor shall agree to clean the premises at no charge to the Owner and to accept all liability for damages claimed or law suits brought against the Owner or it's employees or by the Owner and persons exposed to such contamination.

9. Disposal of Asbestos Waste

A. Procedure for hauling and disposal of waste shall comply with 40 CFR 61 (SUBPART B), State, Regional, and local standards. All asbestos waste, scrap, debris containers, asbestos contaminated clothing and equipment which may produce airborne concentrations of asbestos fibers shall be collected and placed in sealed and properly labeled, 6 mil impermeable bags. For temporary storage, store sealed impermeable bags in asbestos waste containers (drums, skips, etc). This waste material shall be transported in sealed, properly labeled, DOT approved containers and disposed of only at an USEPA or State approved sanitary landfill permitted to receive friable ACM. The procedure for hauling and disposal shall comply with 40 CFR (SUBPART B), State, Regional and local standards. Sealed plastic bags may be hand placed from containers into the burial site unless the bags have been broken or damaged. Damaged bags shall remain in the container and the entire contaminated container shall be buried. Uncontaminated containers may be recycled. Workers unloading the sealed containers shall wear appropriate respirators and personal protective equipment when handling asbestos materials at the disposal site.

PART VII - CLEARANCE AIR MONITORING

1. Clearance air monitoring shall be conducted utilizing the following aggressive air sampling techniques whenever an asbestos containment area is utilized to control release of airborne asbestos fibers.

A. LIMITATIONS:

1. The aggressive air sampling techniques shall be used only in an asbestos containment area with effective negative air filtration, shall be performed only by individuals meeting the licensing requirements described in Section D.1. and shall not be initiated until a visual inspection is conducted and visible ACM and asbestos debris have been removed.

2. The number of samples collected shall be specified for PCM in Section D.2. The acceptable method of analysis for the samples is by

PCM. At the owner's discretion, TEM analysis may be substituted for or used as a supplement to PCM analyses for final clearance.

B. PERSONNEL AND LABORATORY REQUIREMENTS:

1. Individuals performing aggressive air sampling techniques must have a valid asbestos project monitor's license issued by the Department of Professional and Occupational Regulation.

2. The following conflict of interest provisions shall be applicable to individuals performing aggressive air sampling techniques and asbestos analytical laboratories:

   a. Individuals performing aggressive air sampling techniques shall not be employed by or have a financial affiliation with the asbestos abatement or RFS contractor conducting the asbestos abatement project.

   b. Laboratories utilized for aggressive air sampling analyses on projects shall not have a business relationship concerning the projects with the contractors conducting the asbestos abatement activities on the projects, nor have financial affiliation with the contractors.

C. EQUIPMENT REQUIREMENTS:

1. High volume air pumps with necessary peripheral equipment (hoses, connectors, etc) calibrated to draw from four to 10 liters of air per minute (1pm) through the filter must be used for air sampling.

2. Filters must be 25 millimeter mixed cellulose ester (MCE) filters with a 0.8-1.2 micrometer pore size if the filter is to be analyzed by PCM, or a 0.45 micrometer pore size if analyzed by TEM. Sampling cassettes must have 50-millimeter extension cowls and must not have been previously used.

3. Electric leaf blowers with a rating of at least one horsepower, and a type to allow easy decontamination, must be used to initially agitate and suspend any particles in the air. 20 inch x 20-inch stationary box fans must be used to maintain particle suspension for the duration of the air sampling.

D. SAMPLING PROCEDURES:

1. Set up.

   a. Ensure that the area inside the enclosure is visibly clean of all ACM, dust and debris, that spray encapsulant utilized for lockdown purposes has dried, and that the negative air system is and remains fully operational at a rate of four air changes per hour.

   b. For each 1,000 square feet of negative air enclosure space, initially agitate the air with an electric leaf blower for at least five minutes, agitating the air on all horizontal and vertical surfaces. Activate at least one stationary fan for each 10,000 cubic feet of enclosure volume angled toward the ceiling. Keep the stationary fan(s) operational for the duration of the sampling.

   c. Place the air pumps and sampling cassettes such that each covers approximately the same square footage of floor area, and the exposed filter faces of the sampling cassettes are oriented approximately 45 degrees from the horizontal, using tape and clips as necessary to position the sampling cassettes.

   d. Start the pumps and sample for the required time; turning off the air pumps and then the stationary fan(s) when finished.

2. Number of samples.

   The minimum required number of sample cassettes for each enclosure site is listed in the tables below (each set of samples consists of inside samples, ambient air samples, field blanks, and a sealed blank):

Inside

Square Feet of Enclosure	PCM Analysis	TEM Analysis
less than 100	3	5
100 - 500	5	5
500 - 1000	5	5
1000 - 10,000*	5	5

Ambient

Square Feet of Enclosure	PCM Analysis	TEM Analysis

less than 100	0	5
100 - 500	0	5
500 - 1000	0	5
greater than 1000	0	5

*For areas greater than 10,000 square feet, the number of inside air samples to be obtained will increase by one sample for each 5,000 square feet over 10,000 square feet. For example, using TEM an enclosure of 30,000 square feet would require nine inside samples, five ambient air samples, two field blanks, and one sealed blank, for a total of 17 samples in the set.

a. Field blanks required. Not less than 10% of the total inside air sample cassettes, or a minimum of two per set. The cap of each cassette is to be removed for not more than 30 seconds and replaced (before inside and ambient air sampling is initiated) at the following places:

   1. Near the entrance to each abatement area, and

   2. At one of the ambient sites.

b. Sealed blanks required. One sealed sample cassette blank shall be included with each sample set submitted for analysis.

3. Sampling times.

   The run time for each air pump is calculated by dividing the flow rate (lpm) of the pump into the minimum number of liters of air required to be collected (1200 liters for PCM analysis, 1200 liters for TEM analysis) to obtain the required number of minutes.

4. Recording.

   A floor plan indicating the locations of the collected sample cassettes, along with a data sheet indicating the project name, project monitor, location of project, date samples were collected, calibrated flows for each air pump, start and stop times for each air pump, the preferred method of analyses specified, and the calculated number of liters drawn for each cassette sample, shall be transmitted to the laboratory with the cassette samples to be analyzed. The inclusion of these documents is necessary when generating reports on final clearance air sampling for the project.

5. Shipping.

Air sample cassettes shall be shipped in separate containers from bulk samples to prevent sample cassette contamination. Avoid using expanded polystyrene and particle-based packaging materials.

E. LABORATORY ANALYSIS

1. TEM analysis shall be conducted as described in 40 CFR, Part 763, Subpart E, and Appendix A, Unit II.

2. PCM analysis shall be conducted using the National Institute for Occupational Safety and Health (NIOSH) Method 7400 entitled "Fibers" published in the NIOSH Manual of Analytical methods, 3rd Edition, Second Supplement, August 1987.

3. The following minimum information must be reported by the analytical laboratory to the client:

   a. Concentration in structures per square millimeter (TEM) or fibers per cubic centimeter (PCM).

   b. Analytical sensitivity used for the analysis.

   c. Number of asbestos structures (TEM).

   d. Area analyzed.

   e. Volume of air samples (which was initially provided by client).

   f. Average grid size opening.

   g. Number of grids analyzed.

   h. Copy of the count sheet.

   I. Type of asbestos.

   j. Signature of laboratory analyst.

   k. Official laboratory identification.

   l. Floor plan indicating location where samples were obtained (provided initially by client).

F. FINAL CLEARANCE

1. When final clearance is achieved using TEM analysis, the average concentration of asbestos fibers of the five air samples taken inside the abatement area must be no greater than 70 structures per square millimeter.

2. When final clearance is achieved using PCM analysis, the concentration of fibers for each of five samples must be less than or equal to 0.01 fibers per cubic centimeter of air.

3. If the sample cassettes submitted for analysis do not achieve the level of cleanliness specified above for either TEM or PCM analysis, final clearance is not achieved and the abatement site must be recleaned, and new sets of sample cassettes collected and analyzed until the abatement area passes. This process must continue until the abatement area is in compliance with the above standard.

Charles W. Callan
Capital Outlay Program Manager

SECTION 02231

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Nonsaleable Materials

Written permission to dispose of such products on private property shall be filed with the Owner's Representative.

SD-04 Samples

Tree wound paint

Herbicide

Submit samples in cans with manufacturer's label.

1.2 DELIVERY, STORAGE, AND HANDLING

Deliver materials to, store at the site, and handle in a manner which will maintain the materials in their original manufactured or fabricated condition until ready for use.

PART 2 PRODUCTS

2.1 TREE WOUND PAINT

Bituminous based paint of standard manufacture specially formulated for tree wounds.

2.2 HERBICIDE

Comply with Federal Insecticide, Fungicide, and Rodenticide Act (Title 7 U.S.C. Section 136) for requirements on Contractor's licensing, certification and record keeping. Contact the command Pest Control Coordinator prior to starting work.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Roads and Walks

Keep roads, parking lots, and walks free of dirt and debris at all times.

3.1.2 Trees, Shrubs, and Existing Facilities

Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.1.3 Utility Lines

Protect existing utility lines that are indicated to remain from damage. Notify the Owner's Representative immediately of damage to or an encounter with an unknown existing utility line. The Contractor shall be responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, the Contractor shall notify the Owner's Representative in ample time to minimize interruption of the service.

3.2 CLEARING

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct the work. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Trees designated to be left standing within the cleared areas shall be trimmed of dead branches 1-1/2 inches or more in diameter and shall be trimmed of all branches the heights indicated or directed. Limbs and branches to be trimmed shall be neatly cut close to the bole of the tree or main branches. Cuts more than 1-1/2 inches in diameter shall be painted with an approved tree-wound paint. Apply herbicide in accordance with the manufacturer's label to the top surface of stumps designated not to be removed.

3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 PRUNING

Prune trees designated to be left standing within the cleared areas of dead branches 1 1/2 inches or more in diameter; and trim branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1 1/4 inches in diameter with an approved tree wound paint.

3.5 GRUBBING

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the

ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and location for the bioretention area. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.6 DISPOSAL OF MATERIALS

3.6.1 Saleable Timber

1. All timber on the project site noted for clearing and grubbing shall become the property of the Contractor, and shall be recycled or otherwise diverted from a landfill as required by Section 01150 "Construction Waste Management.

3.6.2 Nonsaleable Materials

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be recycled or otherwise diverted from a landfill as required by Section 01150 "Construction Waste Management.

-- End of Section --

SECTION 02315

EXCAVATION, FILLING, AND BACKFILLING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA C600	(1999) Installation of Ductile-Iron Water Mains and Their Appurtenances

ASTM INTERNATIONAL (ASTM)

ASTM C 136	(2004) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 33	(2001a) Concrete Aggregates
ASTM D 1140	(2000) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2000) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2216	(2000) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 2321	(2000) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2487	(2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(2004) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2004) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 698	(2000ae1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600

kN-m/cu. m.))

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 530/F-93/004	(1993; Rev O; Updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846)
EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes

1.2 DEFINITIONS

1.2.1 Capillary Water Barrier

A layer of clean, poorly graded crushed rock, stone, or natural sand or gravel having a high porosity which is placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below a slab.

1.2.2 Degree of Compaction

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 698, for site fill and ASTM D 1557 building fill to 5'-0" outside the building limit. Compaction shall be indicated as percent laboratory maximum density.

1.2.3 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.4 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Locations(s) of product manufacture and of harvest/extraction/recovery of primary materials used in fill.

Designation of the percentages of post-consumer and pre-consumer recycled-content in fill materials.

SD-06 Test Reports

Borrow Site Testing

Fill and backfill test

Select material test

Porous fill test for capillary water barrier

Density tests

Moisture Content Tests

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

1.4 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.5 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.

d. Material character is indicated by the boring logs included in this specification.

e. Hard materials and rock will not be encountered.

f. Borrow material, suitable backfill and bedding material in the quantities required is not available at the project site.

g. Blasting will not be permitted. Remove material in an approved manner.

1.6 REQUIREMENTS FOR OFF SITE SOIL

Soils brought in from off site for use as backfill shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity. Backfill shall contain less than 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCLP test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA 530/F-93/004 Method 5030/8020. TCLP shall be performed in accordance with EPA 530/F-93/004 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Material shall not be brought on

site until tests have been approved by the Owner's Representative.

1.7 QUALITY ASSURANCE

1.7.1 Dewatering Work Plan

Submit procedures for accomplishing dewatering work, if required.

1.7.2 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Excavation made with power-driven equipment is not permitted within two feet of known utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Owner's Representative. Report damage to utility lines or subsurface construction immediately to the Owner's Representative.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

2.1.1 Satisfactory Materials

Any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, SP-SM, SP-SC, CL, free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, and frozen, deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be 3 inches. Materials shall be manufactured and harvested/extracted/recovered within a 500-mile radius of the project site.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 3 inches. The Owner's Representative shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic (plasticity index equals zero). Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

2.1.4 Expansive Soils

Soils that have a plasticity index equal to or greater than 20 when tested in accordance with ASTM D 4318.

2.1.5 Common Fill

Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

2.1.6 Backfill and Fill Material

ASTM D 2487, classification GW, GP, GM, GC, SW, SP, SM, SC with a maximum ASTM D 4318 liquid limit of 35, maximum ASTM D 4318 plasticity index of 12, and a maximum of 25 percent by weight passing ASTM D 1140, No. 200 sieve.

2.1.7 Select Material

Provide materials classified as GW, GP, SW, SP by ASTM D 2487 where indicated. The liquid limit of such material shall not exceed 35 percent when tested in accordance with ASTM D 4318. The plasticity index shall not be greater than 12 percent when tested in accordance with ASTM D 4318, and not more than 35 percent by weight shall be finer than No. 200 sieve when tested in accordance with ASTM D 1140.

2.1.8 Topsoil

Provide as specified in Section 02921 SEEDING.

2.2 POROUS FILL FOR CAPILLARY WATER BARRIER

ASTM C 33 fine aggregate grading with a maximum of 3 percent by weight passing ASTM D 1140, No. 200 sieve, or 1-1/2 inches and no more than 2 percent by weight passing the No. 4 size sieve or coarse aggregate Size 57, 67, or 77 and conforming to the general soil material requirements specified in paragraph entitled "Satisfactory Materials."

2.3 UTILITY BEDDING MATERIAL

Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Piping shall have bedding to spring line of pipe. Provide ASTM D 2321 materials as follows:

a. Class I: Angular, 0.25 to 1.5 inches, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inches, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.

2.4 BORROW

Obtain borrow materials required in excess of those furnished from excavations from sources off-site.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction. The Contractor is responsible for dewatering activity as part of this contract. Dewatering activity could be required during the cistern tank installation. Refer to Geotechnical report included in this specification.

3.1.1.1 Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall construct temporary storm drainage sediment traps at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, dikes, swales, and other drainage features and equipment as required to maintain dry soils, prevent erosion and undermining of foundations. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.1.1.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction.

3.1.2 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction.

3.2 SURFACE PREPARATION

3.2.1 Clearing and Grubbing

Unless indicated otherwise, remove trees, stumps, logs, shrubs, brush and vegetation and other items that would interfere with construction operations within the clearing limits. Remove stumps entirely. Grub out matted roots and roots over 2 inches in diameter to at least 18 inches below existing surface.

3.2.2 Stripping

Strip suitable soil from the site where excavation or grading is indicated

and stockpile separately from other excavated material. Material unsuitable for use as topsoil shall be stockpiled and used for backfilling. Locate topsoil so that the material can be used readily for the finished grading. Where sufficient existing topsoil conforming to the material requirements is not available on site, provide borrow materials suitable for use as topsoil. Protect topsoil and keep in segregated piles until needed.

3.2.3 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed. Refill with select material and compact to 98 percent of ASTM D 698 maximum density for site excavation and 95 percent of ASTM D 1557 for building areas. Unless specified otherwise, refill excavations cut below indicated depth with select material and compact to 98 percent of the required test density maximum density. Satisfactory material removed below the depths indicated, without specific direction of the Owner's representative, shall be replaced with satisfactory materials to the indicated excavation grade. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Owner's Representative.

3.3.1 Structures With Spread Footings and Base Slab (Tank)

Ensure that footing subgrades have been inspected and approved by the Owner's Representative prior to concrete placement. Fill over excavations with concrete during foundation placement.

3.3.2 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement. Tamp if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length.

3.4 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Owner's Representative. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or

natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified herein.

3.4.1 Proof Rolling

Proof rolling shall be done on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After stripping, proof roll the existing subgrade of the building with six passes of a fully loaded tandom dump truck. Operate the truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 2 1/2 to 3 1/2 miles per hour. When proof rolling under buildings, the building subgrade shall be considered to extend 5 feet beyond the building lines, and one-half of the passes made with the roller shall be in a direction perpendicular to the other passes. Notify the Owner's Representative a minimum of 3 days prior to proof rolling. Proof rolling shall be performed in the presence of the Owner's Representative. Rutting or pumping of material shall be undercut as directed by the Owner's Representative and replaced with select material.

3.5 FILLING AND BACKFILLING

Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

3.5.1 Common Fill Placement

Provide for general site Use satisfactory materials. Place in 6 inch lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Finish to a smooth surface by blading, rolling with a smooth roller, or both.

3.5.2 Backfill and Fill Material Placement

Provide for paved areas and under concrete slabs, except where select material is provided. Place in 6 inch lifts. Do not place over wet or frozen areas. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

3.5.3 Select Material Placement

Provide under porous fill of structures. Place in 6 inch lifts and compact to 95 degree of maximum density determind by ASTM D 1557. Do not place over wet or frozen areas. Backfill adjacent to structures shall be placed as structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against structure.

3.5.4 Backfill and Fill Material Placement Over Pipes and at Walls

Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.

3.5.5 Porous Fill Placement

Provide under floor and area-way slabs on a compacted subgrade. Place in 4 inch lifts with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.5.6 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under structures and paved areas in 6 inch lifts to top of trench and in 6 inch lifts to one foot over pipe outside structures and paved areas.

3.6 COMPACTION

Determine in-place density of existing subgrade; if required density exists, no compaction of existing subgrade will be required.

3.6.1 General Site

Compact underneath areas designated for vegetation and areas outside the 5 foot line of the paved area or structure to 90 percent of ASTM D 698, except the bio-retention area, which shall have the installation compactions noted on the plan sheets.

3.6.2 Structures, Spread Footings, and Concrete Slabs

Compact topsubgrades to 95 percent of ASTM D 1557. Compact select material to 95 percent of ASTM D 1557.

3.6.3 Adjacent Area

Compact areas within 5 feet of structures at the finish grade level to 95 percent of ASTM D 1557. Toes of fill slope shall have the same compaction.

3.6.4 Paved Areas

Compact top 12 inches of subgrades to 98 percent of ASTM D 698. Compact fill and backfill materials to 98 percent of ASTM D 698.

3.7 FINISH OPERATIONS

3.7.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. Maintain areas free of trash and debris. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.7.2 Topsoil and Seed

Provide as specified in Section 02921 SEEDING.

3.7.3 Protection of Surfaces

Protect newly backfilled, graded, and topsoiled areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.8 DISPOSITION OF SURPLUS MATERIAL

Remove from site surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber. Recycle or otherwise divert from a landfill all applicable waste as required by Section 01150 "Construction Waste Management.

3.9 FIELD QUALITY CONTROL

3.9.1 Sampling

Take the number and size of samples required to perform the following tests.

3.9.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

3.9.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 4318 for liquid limit and for plastic limit; ASTM D 698 for moisture density relations.

3.9.2.2 Select Material Testing

Test select material in accordance with ASTM C 136 for conformance to ASTM D 2487 gradation limits; ASTM D 1140 for material finer than the No. 200 sieve; ASTM D 698 for moisture density relations.

3.9.2.3 Porous Fill Testing

Test porous fill in accordance with ASTM C 136 for conformance to gradation specified in ASTM C 33.

3.9.2.4 Density Tests

Test density in accordance with ASTM D 1556, or ASTM D 2922 and ASTM D 3017.

When ASTM D 2922 and ASTM D 3017 density tests are used, verify density test results by performing an ASTM D 1557 density test at a location already ASTM D 2922 and ASTM D 3017 tested as specified herein. Perform an ASTM D 1557 density test at the start of the job, and for every 10 ASTM D 2922 and ASTM D 3017 density tests thereafter. Test each lift at randomly selected locations every 2000 square feet of existing grade in fills for structures and concrete slabs, and every 2500 square feet for other fill areas and every 2000 square feet of subgrade in cut. Include density test results in daily report.

3.9.2.5 Moisture Content Tests

In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of materials being placed is required during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved moisture content shall be tested in accordance with ASTM D 2216. Include moisture content test results in daily report.

-- End of Section --

SECTION 02360

SOIL TREATMENT FOR SUBTERRANEAN TERMITE CONTROL

PART 1 GENERAL

1.1 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Termiticides

Manufacturer's label and Material Safety Data Sheet (MSDS) for termiticides proposed for use.

Foundation Exterior

Written verification that other site work will not disturb the treatment.

Verification of Measurement

Written verification that the volume of termiticide used meets the application rate.

Warranty

Copy of Contractor's warranty.

SD-07 Certificates

Qualifications

Qualifications and state license number of the termiticide applicator.

1.2 QUALIFICATIONS

For the application of pesticides, the Contractor shall use the services of a subcontractor whose principal business is pest control. The subcontractor shall be licensed and certified in the state where the work is to be performed. Termiticide applicators shall also be certified in the U.S. Environmental Protection Agency (EPA) pesticide applicator category which includes structural pest control.

1.3 SAFETY REQUIREMENTS

Formulate, treat, and dispose of termiticides and their containers in accordance with label directions. Draw water for formulating only from sites designated by the Owner, and fit the filling hose with a backflow preventer meeting local plumbing codes or standards. The filling operation shall be under the direct and continuous observation of a contractor's representative to prevent overflow. Secure pesticides and related

materials under lock and key when unattended. Ensure that proper protective clothing and equipment are worn and used during all phases of termiticide application. Dispose of used pesticide containers off Owner property.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery

Termiticide material shall be delivered to the site in the original unopened containers bearing legible labels indicating the EPA registration number and manufacturer's registered uses. All other materials to be used on site for the purpose of termite control shall be delivered in new or otherwise good condition as supplied by the manufacturer or formulator.

1.4.2 Storage

Materials shall be stored in designated areas and in accordance with manufacturer's labels. Termiticides and related materials shall be kept under lock and key when unattended.

1.4.3 Handling

Termiticides shall be handled in accordance with manufacturer's labels. Manufacturer's warnings and precautions shall be observed. Materials shall be handled preventing contamination by dirt, water, and organic material. Protect termiticides from sunlight as recommended by the manufacturer.

1.5 INSPECTION

Termiticides shall be inspected upon arrival at the job site for conformity to type and quality in accordance with paragraph TERMITICIDES. Each label shall bear evidence of registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended or under appropriate regulations of the host county. Other materials shall be inspected for conformance with specified requirements. Unacceptable materials shall be removed from the job site.

1.6 WARRANTY

The Contractor shall provide a 5-year written warranty against infestations or reinfestations by subterranean termites of the buildings and cistern tank constructed under this contract. Warranty shall include annual inspections of the buildings or tank. If live subterranean termite infestation or subterranean termite damage is discovered during the warranty period, and the soil and building conditions have not been altered in the interim, the Contractor shall:

a. Retreat the soil and perform other treatment as may be necessary for elimination of subterranean termite infestation;

b. Repair damage caused by termite infestation; and

c. Reinspect the building approximately 180 days after the retreatment.

PART 2 PRODUCTS

2.1 TERMITICIDES

Termiticides shall be currently registered by the EPA. Termiticide shall be selected for maximum effectiveness and duration after application. The selected termiticide shall be suitable for the soil and climatic conditions at the project site.

PART 3 EXECUTION

3.1 TECHNICAL REPRESENTATIVE

The certified installation pest management coordinator shall be the technical representative, shall be present at all meetings concerning treatment measures for subterranean termites, and may be present during treatment application. The Owner's Representative shall be contacted prior to starting work.

3.2 SITE PREPARATION

Site preparation shall be in accordance with Sections 02231 CLEARING AND GRUBBING, 02315 EXCAVATION, FILLING, AND BACKFILLING, 02921 SEEDING, 02930 EXTERIOR PLANTS, and 02935 LANDSCAPE ESTABLISHMENT. Work related to final grades, landscape plantings, foundations, or any other alterations to finished construction which might alter the condition of treated soils, shall be coordinated with this specification.

3.2.1 Ground Preparation

Food sources shall be eliminated by removing debris from clearing and grubbing and post construction wood scraps such as ground stakes, form boards, and scrap lumber from the site, before termiticide application begins.

3.2.2 Verification

Before work starts, the Contractor shall verify that final grades are as indicated and smooth grading has been completed in accordance with Section 02315 EXCAVATION, FILLING AND BACKFILLING. Soil particles shall be finely graded with particles no larger than 1 inch and compacted to eliminate soil movement to the greatest degree.

3.2.3 Foundation Exterior

The Contractor shall provide written verification that final grading and landscape planting operations will not disturb treatment of the soil on the exterior sides of foundation walls, cistern tank, and similar structures.

3.2.4 Utilities

The Contractor shall provide written verification that the location and identity of water and sewer lines, and plumbing have been accomplished prior to the termiticide application.

3.3 SITE CONDITIONS

The following conditions shall determine the time of application.

3.3.1 Soil Moisture

Soils to be treated shall be tested immediately before application. Soil moisture content shall be tested to a minimum depth of 3 inches. The soil moisture shall be as recommended by the termiticide manufacturer. The termiticide will not be applied when soil moisture exceeds manufacturer's recommendations because termiticides do not adhere to the soil particles in saturated soils.

3.3.2 Runoff and Wind Drift

Termiticide shall not be applied during or immediately following heavy rains. Applications shall not be performed when conditions may cause runoff or create an environmental hazard. Applications shall not be performed when average wind speed exceeds 10 miles per hour. The termiticide shall not be allowed to enter water systems, aquifers, or endanger humans or animals.

3.3.2.1 Vapor Barriers and Waterproof Membranes

Termiticide shall be applied prior to placement of a vapor barrier or waterproof membrane.

3.3.3 Placement of Concrete

Concrete covering treated soils shall be placed as soon as the termiticide has reached maximum penetration into the soil. Time for maximum penetration shall be as recommended by the manufacturer.

3.4 TERMITICIDE TREATMENT

The Contractor shall submit a Termiticide Application Plan for approval before starting the specified treatment.

3.4.1 Equipment Calibration and Tank Measurement

Immediately prior to commencement of termiticide application, calibration tests shall be conducted on the application equipment to be used and the application tank shall be measured to determine the volume and contents. These tests shall confirm that the application equipment is operating within the manufacturer's specifications and will meet the specified requirements. The Contractor shall provide written certification of the equipment calibration test results within 1 week of testing.

3.4.2 Mixing and Application

Formulating, mixing, and application shall be performed in the presence of the Contracting Officer or the technical representative. A closed system is recommended as it prevents the termiticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying termiticides shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately.

3.4.3 Treatment Method

For areas to be treated, the Contractor shall establish complete and

unbroken vertical and/or horizontal soil poison barriers between the soil and all portions of the intended structure which may allow termite access to wood and wood related products. Application shall not be made to areas which serve as crawl spaces or for use as a plenum air space.

3.4.3.1 Surface Application

Surface application shall be used for establishing horizontal barriers. Surface applicants shall be applied as a coarse spray and provide uniform distribution over the soil surface. Termiticide shall penetrate a minimum of 1 inch into the soil, or as recommended by the manufacturer.

3.4.3.2 Rodding and Trenching

Rodding and trenching shall be used for establishing vertical soil barriers. Trenching shall be to the depth of the foundation footing. Width of trench shall be as recommended by the manufacturer, or as indicated. Rodding or other approved method may be implemented for saturating the base of the trench with termiticide. Immediately after termiticide has reached maximum penetration as recommended by the manufacturer, backfilling of the trench shall commence. Backfilling shall be in 6 inch rises or layers. Each rise shall be treated with termiticide.

3.4.4 Sampling

The Owner's Reresentative may draw from stocks at the job site, at any time and without prior notice, samples of the termiticides used to determine if the amount of active ingredient specified on the label is being applied.

3.5 VERIFICATION OF MEASUREMENT

Once termiticide application has been completed, tank contents shall be measured to determine the remaining volume. The total volume measurement of used contents for the application shall equal the established application rate for the project site conditions. The Contractor shall provide written verification of the measurements.

3.6 CLEAN UP, DISPOSAL, AND PROTECTION

Once application has been completed, the Contractor shall proceed with clean up and protection of the site without delay.

3.6.1 Clean Up

The site shall be cleaned of all material associated with the treatment measures, according to label instructions, and as indicated. Excess and waste material shall be removed and disposed off site.

3.6.2 Disposal of Termiticide

The Contractor shall dispose of residual termiticides and containers off Owner's property, and in accordance with label instructions and EPA criteria.

3.6.3 Protection of Treated Area

Immediately after the application, the area shall be protected from other use by erecting barricades and providing signage as required or directed. Signage shall be placed inside the entrances to crawl spaces and shall

identify the space as treated with termiticide and not safe for children and animals.

3.7 CONDITIONS FOR SATISFACTORY TREATMENT

3.7.1 Equipment Calibrations and Measurements

Where results from the equipment calibration and tank measurements tests are unsatisfactory, re-treatment will be required.

3.7.2 Testing

Should an analysis, performed by a third party, indicate that the samples of the applied termiticide contain less than the amount of active ingredient specified on the label, and/or if soils are treated to a depth less than specified or approved, re-treatment will be required.

3.7.3 Disturbance of Treated Soils

Soil and fill material disturbed after treatment shall be re-treated before placement of slabs or other covering structures.

3.7.4 Termites Found Within the Warranty Period

If live subterranean termite infestation or termite damage is discovered during the warranty period, the Contractor shall re-treat the site.

3.8 RE-TREATMENT

Where re-treatment is required, the Contractor shall comply with the requirements specified in paragraph WARRANTY.

-- End of Section --

SECTION 02510

WATER DISTRIBUTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA B300	(1999) Hypochlorites
AWWA B301	(2004) Liquid Chlorine
AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	(1998) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1219 mm), for Water
AWWA C111	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151	(2002) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C153	(2000) Ductile-Iron Compact Fittings for Water Service
AWWA C500	(2002; A C500a-95) Metal-Seated Gate Valves for Water Supply Service
AWWA C502	(1994) Dry-Barrel Fire Hydrants
AWWA C503	(1997) Wet-Barrel Fire Hydrants
AWWA C509	(2001) Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	(1999) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C651	(1999) Disinfecting Water Mains
AWWA C700	(2002) Cold-Water Meters - Displacement Type, Bronze Main Case
AWWA C706	(1996; R 2001) Direct-Reading, Remote-Registration Systems for Cold-Water Meters
AWWA C800	(2001) Underground Service Line Valves and

	Fittings
AWWA C901	(2002) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13mm) Through 3 In. (76 mm), for Water Service
AWWA M23	(2002) Manual: PVC Pipe - Design and Installation

ASME INTERNATIONAL (ASME)

ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes

ASTM INTERNATIONAL (ASTM)

ASTM B 61	(2002) Steam or Valve Bronze Castings
ASTM B 62	(2002) Composition Bronze or Ounce Metal Castings
ASTM C 94/C 94M	(2000) Ready-Mixed Concrete
ASTM D 1527	(1999e1) Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80
ASTM D 1785	(2004a) Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2235	(20041) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2241	(2004b) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2282	(1999e1) Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (SDR-PR)
ASTM D 2466	(2002) Poly(Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2468	(1996a) Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 40
ASTM D 2564	(2004) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2774	(2004) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1996; R 2002) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM F 402	(1993; R 1999) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids
NFPA 49	(3003) Hazardous Chemicals Data
NFPA 704	(1996) Identification of the Hazards of Materials for Emergency Response

UNDERWRITERS LABORATORIES (UL)

UL 246	(1993; Rev thru Dec 1998) Hydrants for Fire-Protection Service
UL 262	(2004) Gate Valves for Fire-Protection Service

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-3	(1992) Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe (Nominal Diameters 4-36 Inch)

1.2 DESIGN REQUIREMENTS

1.2.1 Water Distribution Mains

Provide water distribution mains indicated as 6 and 8 inch diameter lines of ductile-iron pipe. Provide water main accessories including gate valves as specified and where indicated.

1.2.2 Water Service Lines

Provide water service lines indicated as 4 inch diameter or less from water distribution main to building. Water service lines shall be polyvinyl chloride (PVC) plastic pipe or acrylonitrile-butadiene-styrene (ABS) plastic pipe. Provide water service line appurtenances as specified and where indicated.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Piping Materials

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Hydrants

Valve boxes

Submit manufacturer's standard drawings or catalog cuts, except

submit both drawings and cuts for push-on bell-and-spigot joints. Include information concerning gaskets with submittal for joints and couplings.

SD-06 Test Reports

Bacteriological Disinfection.

Test results from commercial laboratory verifying disinfection

SD-07 Certificates

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Fire hydrants

Displacement Type Meters

Compound Type Meters

Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the intervals or frequency specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

SD-08 Manufacturer's Instructions

Installation procedures for water piping

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves and hydrants free of dirt and debris.

1.4.2 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place any other material or pipe inside a pipe or fitting after the coating has been applied. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method.

Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Owner. Store rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

1.4.2.1 Polyethylene (PE) Pipe, Fittings, and Accessories

Handle PE pipe, fittings, and accessories in accordance with AWWA C901.

1.4.2.2 Miscellaneous Plastic Pipe and Fittings

Handle Polyvinyl Chloride (PVC), pipe and fittings in accordance with the manufacturer's recommendations. Store plastic piping and jointing materials that are not to be installed immediately under cover out of direct sunlight.

Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS

2.1.1 Piping Materials

2.1.1.1 Ductile-Iron Piping

a. Pipe and Fittings: Pipe, AWWA C151, Pressure Class 150. Fittings, AWWA C110 or AWWA C153 ; fittings with push-on joint ends conforming to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104, twice the standard thickness.

b. Joints and Jointing Material:

(1) Joints: Joints for pipe and fittings shall be push-on joints unless otherwise indicated.

(2) Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly, AWWA C111.

2.1.2 Valves, Hydrants, and Other Water Main Accessories

2.1.2.1 Gate Valves on Buried Piping

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be nonrising stem type with double-disc gates and mechanical-joint ends or push-on joint ends as appropriate for the adjoining pipe, (2) AWWA C509 shall be nonrising stem type with mechanical-joint ends or resilient-seated gate valves 3 to 12 inches in size, and (3) UL 262 shall be inside-screw type with operating nut, double-disc or split-wedge type gate, designed for a hydraulic working pressure of 150 psi, and shall have mechanical-joint ends or push-on joint ends as appropriate for the pipe to which it is joined. Materials for

UL 262 valves shall conform to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have 0-ring stem seals. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair.

2.1.2.2 Fire Hydrants

Paint hydrants with at least one coat of primer and two coats of silver enamel paint.

a. Fire Hydrants: Dry-barrel type hydrants, AWWA C502 or UL 246, "Base Valve" design, shall have 6 inch inlet, 5 1/4 inch valve opening, one 4 1/2 inch pumper connection, and two 2 1/2 inch hose connections. Wet-barrel type hydrants, AWWA C503 or UL 246, "Wet Barrel" design, shall have 6 inch inlet, one 4 1/2 inch pumper connection, and two 2 1/2 inch hose connections. Inlet shall have mechanical-joint or push-on joint end; end shall conform to the applicable requirements as specified for the joint. Size and shape of operating nut, cap nuts, and threads on hose and pumper connections shall be as specified in AWWA C502 or AWWA C503 or UL 246

2.1.2.3 Valve Boxes

Provide a valve box for each gate valve on buried piping. Valve boxes shall be of cast iron or precast concrete of a size suitable for the valve on which it is to be used and shall be adjustable. Cast-iron boxes shall have a minimum cover and wall thickness of 3/16 inch. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5 1/4 inches. Cast-iron box shall have a heavy coat of bituminous paint.

2.2 WATER SERVICE LINE MATERIALS

2.2.1 Piping Materials

2.2.1.1 Plastic Piping

Plastic pipe and fittings shall bear the seal of the National Sanitation Foundation (NSF) for potable water service. Plastic pipe and fittings shall be supplied from the same manufacturer.

a. Polyvinyl Chloride (PVC) Plastic Piping: ASTM D 1785, Schedule 40; or ASTM D 2241, with SDR as necessary to provide 150 psi minimum pressure rating. Fittings, ASTM D 2466. Pipe and fittings shall be of the same PVC plastic material and shall be one of the following pipe/fitting combinations, as marked on the pipe and fitting, respectively: PVC 2120/PVC II; PVC 2116/PVC II. Solvent cement for jointing, ASTM D 2564.

b. Acrylonitrile-butadiene-styrene (ABS) Plastic Piping: ASTM D 1527 or ASTM D 2282, with pipe schedule or SDR as necessary to provide 150 psi minimum pressure rating. Fittings, ASTM D 2468, as required to provide barrel wall thickness not less than that of the pipe. Solvent cement for jointing, ASTM D 2235.

2.2.1.2 Insulating Joints

Joints between pipe of dissimilar metals shall have a rubber-gasketed or

other suitable approved type of insulating joint or dielectric coupling which will effectively prevent metal-to-metal contact between adjacent sections of piping.

2.2.2 Water Service Line Appurtenances

2.2.2.1 Corporation Stops

Ground key type; bronze, ASTM B 61 or ASTM B 62; and suitable for the working pressure of the system. Ends shall be suitable for solder-joint, or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, AWWA C800; coupling nut for connection to flared copper tubing, ASME B16.26.

2.2.2.2 Gate Valves 3 Inch Size and Larger on Buried Piping

Gate valves 3 inch size and larger on buried piping AWWA C500 or UL 262 and of one manufacturer. Valves, AWWA C500, nonrising stem type with double-disc gates. Valves, UL 262, inside-screw type with operating nut, split wedge or double disc type gate, and designed for a hydraulic working pressure of 175 psi. Materials for UL 262 valves conforming to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have 0-ring stem seals and shall be bolted and constructed so as to permit easy removal of parts for repair. Valves shall have ends suitable for joining to the pipe used; push-on joint ends or mechanical-joint ends for joining to PVC plastic water pipe; gaskets and pipe ends, AWWA C111.

2.2.2.3 Valve Boxes

Provide a valve box for each gate valve on buried piping. Valve boxes shall be of cast iron or precast concrete of a size suitable for the valve on which it is to be used and shall be adjustable. Provide a round head. Cast the word "WATER" on the lid. The least diameter of the shaft of the box shall be 5 1/4 inches. Cast-iron box shall have a heavy coat of bituminous paint.

2.2.2.4 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 50 foot-pound.

2.2.2.5 Displacement Type Meters

Displacement type meters shall conform to AWWA C700. Registers shall be straight-reading and shall read in U.S. gallons. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706. Meters shall comply with the accuracy and capacity requirements

of AWWA C700.

2.2.2.6 Meter Boxes

Meter boxes shall be of cast iron, concrete, or plastic. The boxes shall be of sufficient size to completely enclose the meter and shutoff valve or service stop. Meter boxes set in paved areas subject to vehicular traffic shall be cast iron, or concrete with cast iron lid and cast iron meter reader lid. Boxes set in sidewalks, not subject to vehicular traffic, shall be concrete with cast iron lid and cast iron meter reader lid. Plastic boxes and lids may be used in unpaved areas or grass areas not subject to vehicular traffic. Box height shall extend from invert of the meter to final grade at the meter location. The lid shall have the word "WATER" cast in it.

2.2.2.7 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

Where the location of the water line is not clearly defined by dimensions on the drawings, do not lay water line closer horizontally than 10 feet from any sewer line. Where water lines cross under gravity sewer lines, encase sewer line fully in concrete for a distance of at least 10 feet on each side of the crossing, unless sewer line is made of pressure pipe with rubber-gasketed joints and no joint is located within 3 feet horizontally of the crossing. Do not lay water lines in the same trench with gas lines, fuel lines or electric wiring.

a. Water Piping Installation Parallel With Sewer Piping

(1) Normal Conditions: Lay water piping at least 10 feet horizontally from a sewer or sewer manhole whenever possible. Measure the distance edge-to-edge.

(2) Unusual Conditions: When local conditions prevent a horizontal separation of 10 feet, the water piping may be laid closer to a sewer or sewer manhole provided that:

(a) The bottom (invert) of the water piping shall be at least 18 inches above the top (crown) of the sewer piping.

(b) Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling.

Approved waste water disposal method shall be utilized.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of Water Piping Crossing Sewer Piping

(1) Normal Conditions: Water piping crossing above sewer piping shall be laid to provide a separation of at least 18 inches between the bottom of the water piping and the top of the sewer piping.

(2) Unusual Conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sewer piping passing over or under water piping shall be constructed of AWWA-approved ductile iron water piping, pressure tested in place without leakage prior to backfilling.

(b) Water piping passing under sewer piping shall, in addition, be protected by providing a vertical separation of at least 18 inches between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 20 feet, of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.

c. Sewer Piping or Sewer Manholes: No water piping shall pass through or come in contact with any part of a sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 02315.

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe in a neat workmanlike manner accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation.

Depth of cover over top of pipe shall not be less than 2 1/2 feet.

3.1.1.4 Connections to Existing Water Lines

Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines in accordance with the recommended procedures of the manufacturer of the pipe being tapped.

3.1.2 Special Requirements for Installation of Water Mains

3.1.2.1 Installation of Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

a. Jointing: Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111.

b. Allowable Deflection: The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

c. Pipe Anchorage: Provide concrete thrust blocks for pipe anchorage. Thrust blocks shall be in accordance with the requirements of AWWA C600 for thrust restraint, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94/C 94M, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.2 Installation of Valves and Hydrants

a. Installation of Valves: Install gate valves, AWWA C509, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509. Install gate valves on PVC water mains in accordance with the recommendations for appurtenance installation in AWWA M23, Chapter 7, "Installation." Make and assemble joints to gate valves as specified for making and assembling the same type joints between pipe and fittings.

b. Installation of Hydrants: Install hydrants in accordance with AWWA C600 for hydrant installation and as indicated. Make and assemble joints as specified for making and assembling the same type joints between pipe and fittings. Install hydrants with the 4 1/2 inch connections facing the adjacent paved surface.

3.1.3 Installation of Water Service Piping

3.1.3.1 Location

Connect water service piping to the building service where the building service has been installed. Where building service has not been installed, terminate water service lines at a point directed by the Owner's Representative; such water service lines shall be closed with plugs or caps.

3.1.3.2 Service Line Connections to Water Mains

Connect service lines to the main with a rigid connection and install a gate valve on service line below the frostline. Connect service lines to ductile-iron water mains in accordance with AWWA C600 for service taps.

3.1.4 Special Requirements for Installation of Water Service Piping

3.1.4.1 Installation of Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of ASTM D 2774 and ASTM D 2855, unless otherwise specified. Handle solvent cements used to join plastic piping in accordance with ASTM F 402.

a. Jointing: Make solvent-cemented joints for PVC plastic piping using the solvent cement previously specified for this material; assemble joints in accordance with ASTM D 2855. Make solvent-cemented joints for ABS plastic piping using the solvent cement previously specified for this material; assemble joints in accordance with the recommendations of the pipe manufacturer, as approved. Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

b. Plastic Pipe Connections to Appurtenances: Connect plastic pipe service lines to corporation stops and gate valves in accordance with the recommendations of the plastic pipe manufacturer.

c. Install a continous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such a manner that it will not be displaced during construction operations.

3.1.4.2 Location of Meters

Meters and meter boxes shall be installed at the locations shown on the drawings. The meters shall be centered in the boxes to allow for reading and ease of removal or maintenance.

3.1.5 Disinfection

Prior to disinfection, obtain Owner's Representative approval of the proposed method for disposal of waste water from disinfection procedures. Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual

chlorine content is within the range of 0.2 and 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service. Disinfection of systems supplying nonpotable water is not required.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

Prior to hydrostatic testing, obtain Owner's Representative approval of the proposed method for disposal of waste water from hydrostatic testing. The Owner's Representative will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications. Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.

3.2.2 Testing Procedure

Test water mains and water service lines in accordance with the applicable specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements." Test ductile-iron water mains in accordance with the requirements of AWWA C600 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in AWWA C600. Test PVC plastic water service lines in accordance with the requirements of UBPPA UNI-B-3 for pressure and leakage tests. The amount of leakage on pipelines made of PVC plastic water main pipe shall not exceed the amounts given in UBPPA UNI-B-3.

3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 2 inches in diameter, hydrostatic test pressure shall be not less than 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

3.3 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

-- End of Section --

SECTION 02531

SANITARY SEWERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 270	(2004a) Mortar for Unit Masonry
ASTM C 443	(2003) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 478	(2003a) Precast Reinforced Concrete Manhole Sections
ASTM C 923	(2002) Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 969	(2002) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C 972	(2000) Compression-Recovery of Tape Sealant
ASTM C 990	(2001a) Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealers
ASTM D 2321	(2000) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2412	(2002) Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 3034	(2004) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1996a; R 2003) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 4101	(2005a) Polypropylene Injection And Extrusion Materials
ASTM D 412	(1998a; R 2002e1) Vulcanized Rubber and Thermoplastic Elastomers - Tension

ASTM D 624	(2000e2) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM F 477	(2002e1) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 949	(2001a) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1998) Recommended Practice for the Low-Pressure Air Testing of Installed Sewer Pipe

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-60005	(Basic) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.27	Fixed Ladders

1.2 SYSTEM DESCRIPTION

1.2.1 Sanitary Sewer Gravity Pipeline

Provide mains, laterals and building connections of polyvinyl chloride (PVC) plastic pipe.

Provide new and modify existing exterior sanitary gravity sewer piping and appurtenances. Provide each system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified herein.

1.3 GENERAL REQUIREMENTS

The construction required herein shall include appurtenant structures and building sewers to points of connection with the existing sanitary sewer system. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Owner. Backfilling shall be accomplished after inspection by the Owner. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Owner's Representative. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions

SD-02 Shop Drawings

Precast concrete manhole

Metal items

Frames, covers, and gratings

Installation Drawings

As-Built Drawings

SD-03 Product Data

Pipeline materials

Submit manufacturer's standard drawings or catalog cuts.

SD-06 Test Reports

Inspection Reports

SD-07 Certificates

Portland Cement

Certificates of compliance stating the type of cement used in manufacture of precast manholes.

1.5 DRAWINGS

Submit Installation Drawings showing complete detail, both plan and side view details with proper layout and elevations.

Submit As-Built Drawings for the complete sanitary sewer system showing complete detail with all dimensions, both above and below grade, including invert elevation.

1.6 EXISTING CONDITIONS

Existing Conditions shall be submitted after a thorough inspection of the area by the Contractor in the presence of the Owner's Representative. Details shall include the condition of other areas adjacent to site work. Submit copies of the record and state the existing conditions before starting work shall be verified.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Delivery and Storage

1.7.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.7.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.7.1.3 Cement, Aggregate, and Reinforcement

As specified in Section 03300 CAST-IN-PLACE CONCRETE.

1.7.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Carry, do not drag, pipe to trench.

1.8 INSTALLER QUALIFICATIONS

Install specified materials by an underground utility contractor licensed for such work in the Commonwealth of Virginia.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 PVC Plastic Gravity Sewer Piping

2.1.1.1 PVC Plastic Gravity Pipe and Fittings

ASTM D 3034, SDR 35, or ASTM F 949 with ends suitable for elastomeric gasket joints.

2.1.1.2 PVC Plastic Gravity Joints and Jointing Material

Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.

2.2 CONCRETE MATERIALS

2.2.1 Cement Mortar

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Precast Concrete Manholes

Precast concrete manhole risers, base sections, and tops shall conform to ASTM C 478; base and first riser shall be monolithic.

2.3.2 Gaskets and Connectors

Gaskets for joints between manhole sections shall conform to ASTM C 443. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C 923 or ASTM C 990.

2.3.3 External Preformed Rubber Joint Seals

An external preformed rubber joint seal shall be an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" shall be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Proplene Di Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings. Properties and values are listed in the following tables:

Properties, Test Methods and Minimum Values for Rubber used in Preformed Joint Seals

Physical Properties	Test Methods	EPDM	Neoprene	Butyl mastic
Tensile, psi	ASTM D 412	1840	2195	-
Elogation percent	ASTM D 412	553	295	350
Tear Resistance, ppi	ASTM D 624 (Die B)	280	160	-
Rebound, percent, 5 minutes	ASTM C 972 (mod.)	-	-	11
Rebound, percent, 2 hours	ASTM C 972	-	-	12

2.3.4 Metal Items

2.3.4.1 Frames, Covers, and Gratings for Manholes

FS A-A-60005, cast iron; figure numbers shall be as follows:

a. Traffic manhole: Provide in paved areas.

Frame: Figure 1, Size 22A
Cover: Figure 8, Size 22A
Steps: Figure 19

b. Non-traffic manhole:

Frame: Figure 4, Size 22
Cover: Figure 12, Size 22
Steps: Figure 19

Frames and covers shall be cast iron or ductile iron. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 400 pounds. The word "Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.4.2 Manhole Steps

Zinc-coated steel conforming to 29 CFR 1910.27. As an option, plastic or rubber coating pressure-molded to the steel may be used. Plastic coating shall conform to ASTM D 4101, copolymer polypropylene. Rubber shall conform to ASTM C 443, except shore A durometer hardness shall be 70 plus or minus 5. Aluminum steps or rungs will not be permitted. Steps are not required in manholes less than 4 feet deep.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

3.1.1 Location

The work covered by this section shall extend from the building to the point of connection with the existing sewer. Do not lay sewer line closer horizontally than 10 feet to a water main or service line. Where sanitary sewer lines pass above water lines, encase sewer in concrete for a distance of 10 feet on each side of the crossing, or substitute rubber-gasketed pressure pipe for the pipe being used for the same distance. Where sanitary sewer lines pass below water lines, lay pipe so that no joint in the sewer line will be closer than3 feet, horizontal distance, to the water line.

a. Sanitary piping installation parallel with water line:

(1) Normal conditions: Sanitary piping or manholes shall be laid at least 10 feet horizontally from a water line whenever possible. The distance shall be measured edge-to-edge.

(2) Unusual conditions: When local conditions prevent a horizontal separation of 10 feet, the sanitary piping or manhole may be laid closer to a water line provided that:

(a) The top (crown) of the sanitary piping shall be at least 18 inches below the bottom (invert) of the water main.

(b) Where this vertical separation cannot be obtained, the sanitary piping shall be constructed of AWWA-approved ductile iron water pipe pressure tested in place without leakage prior to backfilling.

(c) The sewer manhole shall be of watertight construction and

tested in place.

b. Installation of sanitary piping crossing a water line:

(1) Normal conditions: Lay sanitary sewer piping by crossing under water lines to provide a separation of at least 18 inches between the top of the sanitary piping and the bottom of the water line whenever possible.

(2) Unusual conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sanitary piping passing over or under water lines shall be constructed of AWWA-approved ductile iron water pipe, pressure tested in place without leakage prior to backfilling.

(b) Sanitary piping passing over water lines shall, in addition, be protected by providing:

1. A vertical separation of at least 18 inches between the bottom of the sanitary piping and the top of the water line.

2. Adequate structural support for the sanitary piping to prevent excessive deflection of the joints and the settling on and breaking of the water line.

3. That the length, minimum 20 feet, of the sanitary piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the water line.

c. Sanitary sewer manholes: No water piping shall pass through or come in contact with any part of a sanitary sewer manhole.

3.1.2 Earthwork

Perform earthwork operations in accordance with Section 02315 EARTHWORK.

3.1.2 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay nonpressure pipe with the bell ends in the upgrade direction. Adjust spigots in bells to give a uniform space all around. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose.

Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

3.1.3 BURIED WARNING AND IDENTIFICATION TAPE

Install tape in accordance with manufacturer's recommendations except as

modified herein. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

Color of tape shall be as follows:

Blue over Waterline

Red over Electrical Buried Conductor

Yellow over Gas Line

3.1.4 BURIED DETECTION WIRE

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length.

3.1.5 Installation of PVC Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM D 2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of ASTM D 2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.1.6 Manhole Construction

Use precast concrete base sections. Make inverts in precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for precast concrete manholes. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

3.1.7 Miscellaneous Construction and Installation

3.1.7.1 Connecting to Existing Manholes

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the

diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.1.7.2 Metal Work

a. Workmanship and finish: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.

b. Field painting: After installation, clean cast-iron frames, covers, gratings, and steps not buried in concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The Owner's Representative will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests and provide labor, equipment, and incidentals required for testing. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.2.2 Tests for Nonpressure Lines

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line.

3.2.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

a. Infiltration tests and exfiltration tests: Perform these tests for sewer lines made of the specified materials, not only concrete, in accordance with ASTM C 969. Make calculations in accordance with the Appendix to ASTM C 969.

b. Low-pressure air tests: Perform tests as follows:

(1) PVC plastic pipelines: Test in accordance with UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

3.2.2.2 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads determined in accordance with ASTM D 2412. Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

a. Pull-through device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided the device meets the applicable requirements specified in this paragraph, including those for diameter of the device, and that the mandrel has a minimum of 9 arms. Ball, cylinder, or circular sections shall conform to the following:

   (1) A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.

   (2) Homogeneous material throughout, shall have a density greater than 1.0 as related to water at 39.2 degrees F, and shall have a surface Brinell hardness of not less than 150.

   (3) Center bored and through-bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of not less than 70,000 pounds per square inch, with eyes or loops at each end for attaching pulling cables.

   (4) Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

b. Deflection measuring device: Sensitive to 1.0 percent of the diameter of the pipe being tested and shall be accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved prior to use.

c. Pull-through device procedure: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions.

d. Deflection measuring device procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, replace pipe which has excessive deflection and completely retest in same manner and under same conditions.

-- End of Section --

SECTION 02630

STORM DRAINAGE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(1997e1) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 48/A 48M	(2003) Gray Iron Castings
ASTM A 536	(1984; R 2004) Ductile Iron Castings
ASTM B 26/B 26M	(2003) Aluminum-Alloy Sand Castings
ASTM C 1103	(2003)Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C 270	(2004a) Mortar for Unit Masonry
ASTM C 425	(2004) Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 478	(2003a) Precast Reinforced Concrete Manhole Sections
ASTM C 828	(2003) Low-Pressure Air Test of Vitrified Clay Pipe Lines
ASTM C 923	(2002) Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 924	(2002) Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM D 1557	(2000) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 1784	(2003) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2167	(1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method

ASTM D 2321	(2000) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2922	(2004) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2004) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3034	(2004) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1996a; R 2003) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3350	(2002a) Polyethylene Plastics Pipe and Fittings Materials
ASTM F 1417	(1992; R 1998) Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
ASTM F 714	(2003) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Placing Pipe

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

SD-04 Samples

Pipe for Storm Drains

SD-07 Certificates

Resin Certification
Pipeline Testing
Hydrostatic Test on Watertight Joints
Determination of Density
Frame and Cover for Gratings

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed. Certification on the ability of frame and cover or gratings to carry the imposed live load.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Owner's Representative. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR STORM DRAINS

Pipe for storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 PVC Pipe

The pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe, shall be submitted prior to installation of the pipe.

2.1.1.1 Type PSM PVC Pipe

ASTM D 3034, Type PSM, maximum SDR 35, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.2 HDPE Pipe

The pipe manufacturer's resin certification indicating the cell classification of PE used to manufacture the pipe shall be submitted prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D 3350.

2.1.2.1 Smooth Wall HDPE Pipe

ASTM F 714, maximum DR of 21 for pipes 3 to 24 inches in diameter and maximum DR of 26 for pipes 26 to 48 inches in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 335434C.

2.2 DRAINAGE STRUCTURES

2.2.1 Standard Curb Drop Inlets

Sections shall be DI-2A, 2B or 2C in accordance with VDOT standard data sheet 104.03

2.3 MISCELLANEOUS MATERIALS

2.3.1 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.2 Precast Reinforced Concrete Manholes

Precast reinforced concrete manholes shall conform to ASTM C 478. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.3 Frame and Cover for Gratings

Frame and cover for gratings shall be cast gray iron, ASTM A 48/A 48M, Class 35B; cast ductile iron, ASTM A 536, Grade 65-45-12; or cast aluminum, ASTM B 26/B 26M, Alloy 356.OT6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans.

2.3.4 Joints

2.3.4.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with factory-fabricated resilient materials. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice.

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.4.2 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.4 STEEL LADDER

Steel ladder shall be provided where the depth of the manhole exceeds 12 feet. These ladders shall be not less than 16 inches in width, with 3/4

inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2-1/2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

2.5 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C 923.

2.6 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.6.1 PVC and HDPE Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Test requirements for joints in PVC and HDPE plastic pipe shall conform to ASTM D 3212.

PART 3 EXECUTION

3.1 EXCAVATION FOR STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation and backfilling of trenches for storm drains and appurtenances shall be in accordance with the applicable portions of Section 02300 EARTHWORK and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 12 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified. Contractor shall not overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Owner.

3.1.2 Removal of Rock

Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between unremoved rock and the pipe of at least 8 inches or 1/2 inch for each foot of fill over the top of the pipe, whichever is greater, but not more than three-fourths the nominal diameter of the pipe. Where bell-and-spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined in Section 02300 EARTHWORK.

3.1.3 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Owner's Representative, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of

unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Owner.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Plastic Pipe

Bedding for PVC and PE pipe shall meet the requirements of ASTM D 2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

Provide tracer wire in trench with all non-metallic piping in accordance with Section 02531

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (%)
Plastic	7.5

Not less than 30 days after the completion of backfilling, the Owner may perform a deflection test on the entire length of installed flexible pipe using a mandrel or other suitable device. Installed flexible pipe showing deflections greater than those indicated above shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced.

3.3.1 Plastic Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe pointing in the direction of the flow.

3.4 JOINTING

3.4.1 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of precast reinforced concrete, complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in

compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 12 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Owner's Representative, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.3 Compaction

3.7.3.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.3.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

a. Under paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

c. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.7.4 Determination of Density

Testing shall be the responsibility of the Contractor and performed at no additional cost to the Owner. Testing shall be performed by an approved

commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017 or ASTM D 2922. Test results shall be furnished to the Owner's Representative. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.8 PIPELINE TESTING

3.8.1 Leakage Tests

Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate. Low pressure air testing for plastic pipe shall comform to ASTM F 1417.Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 or ASTM C 924, after consultation with the pipe manufacturer. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C 1103. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 0.2 gallons per inch in diameter per 100 feet of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished.

3.8.2 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

a. Pull-through device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance from external faces of front and back

sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided that the device meets the applicable requirements specified in this paragraph, including those for diameter of the device. Ball, cylinder, or circular sections shall conform to the following:

(1) A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.

(2) A homogeneous material throughout, with a density greater than 1.0 as related to water at 39.2 degrees F, and a surface Brinell hardness of not less than 150.

(3) Center bored and through bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of not less than 70,000 psi, with eyes or loops at each end for attaching pulling cables.

(4) Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

b. Deflection measuring device: Sensitive to 1.0 percent of the diameter of the pipe being tested and accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved by the Owner's Representative prior to use.

c. Pull-through device: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions as specified.

d. Deflection measuring device procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, remove pipe which has excessive deflection, replace with new pipe, and completely retest in same manner and under same conditions.

e. Warranty period test: Pipe found to have a deflection of greater than 5 percent of average inside diameter when deflection test is performed just prior to end of one-year warranty period shall be replaced with new pipe and tested as specified for leakage and deflection.

-- End of Section --

SECTION 02631

CISTERN

PART 1 GENERAL

1.1 SUBMITTALS PROCESS

The following shall be submitted in accordance with Section 01300 "SUBMITTAL PROCEDURES".

1.1.1 Material Submittals

Material submittals shall conform to the requirements indicated in the following Sections: 03300 "CAST IN PLACE STRUCTURAL CONCRETE", and 15400 "PLUMBING, GENERAL PURPOSE".

PART 2 PRODUCTS

2.1 EXCAVATION AND BACKFILL

Excavation and Backfill shall be in accordance with Section 02315 "EXCAVATION, FILLING, AND BACKFILLING".

2.2 REINFORCED CONCRETE

Reinforced concrete shall be in accordance with Division 03 Concrete.

2.3 PIPING GENERAL PURPOSE

Piping, Plumbing, and other equipment shall be in accordance with Section 15400 "PLUMBING, GENERAL PURPOSE".

PART 3 EXECUTION

3.1 WORK EXECUTION

The work shall be as specified in Sections 02315, 03200, 03300, and 15400.

Provide tracer wire in trench over non-metallic piping as specified in Section 02531.

-- End of Section --

SECTION 02761

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 792	(2000) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D 4505	(2001a) Preformed Retroreflective Pavement Marking Tape for Extended Service Life
ASTM E 28	(1999) Softening Point of Resins Derived from Naval Stores by Ring and Ball Apparatus

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

ICRI 03732	(1997) Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-B-1325	(Rev C) Beads (Glass Spheres) Retro-Reflective (Metric)
FS TT-P-1952	(Rev D; Notice 1) Paint, Traffic and Airfield Marking, Waterborne (Metric)

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Paints for roads and streets

Thermoplastic compounds and primer

Qualifications

Documentation on personnel qualifications, as specified.

SD-06 Test Reports

Paints for roads and streets

Thermoplastic compounds and primer

Certified reports from sampling and testing made in accordance with paragraph entitled "Sampling and Testing" prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory.

SD-07 Certificates

Paints for roads and streets

Volatile Organic Compound (VOC)

Certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located.

Thermoplastic compounds and primer

SD-08 Manufacturer's Instructions

Paints for roads and streets

Thermoplastic compounds and primer

Submit manufacturer's Material Safety Data Sheets.

1.3 DELIVERY AND STORAGE

Deliver paints, paint materials and thermoplastic compound materials in original sealed containers that plainly show the designated name, specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer. Provide storage facilities at the job site for maintaining materials at temperatures recommended by the manufacturer. Make available paint stored at the project site or segregated at the source for sampling not less than 30 days prior to date of required approval for use to allow sufficient time for testing. Notify the Owner's Representative when paint is available for sampling.

1.4 WEATHER LIMITATIONS

Apply paint to clean, dry surfaces, and unless otherwise approved, only when the air and pavement surface temperature is at least 5 degrees above the dew point and the air and pavement temperatures are above 40 degrees F and less than 95 degrees F for oil-based materials; above 50 degrees F and less than 110 degrees F for water-based materials. Maintain paint temperature within these same limits.

1.5 EQUIPMENT

Machines, tools, and equipment used in the performance of the work shall be approved by the Owner's Representative and maintained in satisfactory operating condition.

1.5.1 Mobile and Maneuverable

Application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

1.5.2 Paint Application Equipment

1.5.2.1 Self-Propelled or Mobile-Drawn Pneumatic Spraying Machines

Provide self-propelled or mobile-drawn pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. Provide machine having a speed during application capable of applying the stripe widths indicated at the paint coverage rate specified herein and of even uniform thickness with clear-cut edges. Provide equipment used for marking streets and highways capable of placing the prescribed number of lines at a single pass as solid lines, intermittent lines, or a combination of solid and intermittent lines using a maximum of three different colors of paint as specified. Provide paint applicator with paint reservoirs or tanks of sufficient capacity and suitable gages to apply paint in accordance with requirements specified. Equip tanks with suitable air-driven mechanical agitators. Equip spray mechanism with quick-action valves conveniently located, and include necessary pressure regulators and gages in full view and reach of the operator. Install paint strainers in paint supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray guns. The paint applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Provide pneumatic spray guns for hand application of paint in areas where the mobile paint applicator cannot be used. Applicator for water-based markings shall be equipped with non-stick coated hoses; metal parts in contact with the paint material shall be constructed of grade 302, 304, 316, or equal stainless steel.

1.5.3 Thermoplastic Application Equipment

1.5.3.1 Thermoplastic Material

Thermoplastic material shall be applied to the primed pavement surface by spray techniques or by the extrusion method, wherein one side of the shaping die is the pavement and the other three sides are contained by, or are part of, suitable equipment for heating and controlling the flow of material. By either method, the markings shall be applied with equipment that is capable of providing continuous uniformity in the dimensions of the stripe.

1.5.3.2 Application Equipment

a. Application equipment shall provide continuous mixing and agitation of the material. Conveying parts of the equipment between the main material reservoir and the extrusion shoe or spray gun shall prevent accumulation and clogging. All parts of the equipment which come into contact with the material shall be easily accessible and exposable for cleaning and maintenance. All mixing and conveying parts up to and including the extrusion shoes and spray guns shall maintain the material at the required temperature with heat-transfer oil or electrical-element-controlled heat.

b. The application equipment shall be constructed to ensure continuous

uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off stripe ends squarely and shall provide a method of applying "skiplines". The equipment shall be capable of applying varying widths of traffic markings.

c. The applicator shall be equipped with a drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow. The bead dispenser shall be automatically operated and shall begin flow prior to the flow of composition to assure that the strip is fully reflectorized.

1.5.3.3 Mobile and Maneuverable

Application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. The equipment used for the placement of thermoplastic pavement markings shall be of two general types: mobile applicator and portable applicator.

1.5.3.4 Mobile Application Equipment

The mobile applicator shall be defined as a truck-mounted, self-contained pavement marking machine that is capable of hot applying thermoplastic by either the extrusion or spray method. The unit shall be equipped to apply the thermoplastic marking material at temperatures exceeding 375 degrees F, at widths varying from 3 to 12 inches and in thicknesses varying from 0.040 to 0.200 inch and shall have an automatic drop-on bead system. The mobile unit shall be capable of operating continuously and of installing a minimum of 20,000 lineal feet of longitudinal markings in an 8-hour day.

The mobile unit shall be equipped with a melting kettle which holds a minimum of 6000 pounds of molten thermoplastic material. The kettle shall be capable of heating the thermoplastic composition to temperatures of 375 to 425 degrees F. A thermostatically controlled heat transfer liquid shall be used. Heating of the composition by direct flame shall not be allowed. Oil and material temperature gauges shall be visible at both ends of the kettle.

The mobile unit shall be equipped with an electronic programmable line pattern control system. The control system shall be capable of applying skip or solid lines in any sequence, through any and all of the extrusion shoes, or the spray guns, and in programmable cycle lengths. In addition, the mobile unit shall be equipped with an automatic counting mechanism capable of recording the number of lineal feet of thermoplastic markings applied to the pavement surface with an accuracy of 0.5 percent.

1.5.3.5 Portable Application Equipment

The portable applicator shall be defined as hand-operated equipment, specifically designed for placing special markings such as crosswalks, stopbars, legends, arrows, and short lengths of lane, edge and centerlines. The portable applicator shall be capable of applying thermoplastic pavement markings by the extrusion method. The portable applicator shall be loaded with hot thermoplastic composition from the melting kettles on the mobile applicator. The portable applicator shall be equipped with all the necessary components, including a materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, so as to be capable of holding the molten thermoplastic at a temperature of 375 to 425 degrees F, of extruding a line of 3 to 12 inches in width, and in thickness of not less than 0.120 inch nor more than 0.190 inch and of generally uniform

cross section.

1.5.4 Reflective Media Dispenser

The dispenser for applying the reflective media shall be attached to the paint dispenser and shall operate automatically and simultaneously with the applicator through the same control mechanism. The dispenser shall be capable of adjustment and designed to provide uniform flow of reflective media over the full length and width of the stripe at the rate of coverage specified in paragraph APPLICATION, at all operating speeds of the applicator to which it is attached.

1.5.5 Preformed Tape Application Equipment

Mechanical application equipment shall be used for the placement of preformed marking tape. Mechanical application equipment shall be defined as a mobile pavement marking machine specifically designed for use in applying precoated, pressure-sensitive pavement marking tape of varying widths, up to 12 inches. The applicator shall be equipped with rollers, or other suitable compactive device, to provide initial adhesion of the preformed, pressure-sensitive marking tape with the pavement surface. Additional hand-operated rollers shall be used as required to properly seat the thermoplastic tape.

1.5.6 Surface Preparation Equipment

1.5.6.1 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 150 cfm of air at a pressure of not less than 90 psi at each nozzle used, and shall be equipped with traps that will maintain the compressed air free of oil and water.

1.5.6.2 Waterblast Equipment

The water pressure shall be specified at 2600 psi at 140 degrees F in order to adequately clean the surfaces to be marked. Water will be furnished at no cost to the Contractor from a fire hydrant designated by the Owner's Representative. Representative and located within a reasonable proximity to the work area. The Contractor shall install a gate valve and a back-flow prevention device on the fire hydrant tap. The Contractor shall furnish all equipment, material, and labor required to obtain and deliver water from the designated fire hydrant to the work area(s).

1.5.7 Marking Removal Equipment

Equipment shall be mounted on rubber tires and shall be capable of removing markings from the pavement without damaging the pavement surface or joint sealant. Waterblasting equipment shall be capable of producing an adjustable, pressurized stream of water. Sandblasting equipment shall include an air compressor, hoses, and nozzles. The compressor shall be equipped with traps to maintain the air free of oil and water.

1.5.7.1 Shotblasting Equipment

Shotblasting equipment shall be capable of producing an adjustable depth of removal of marking and pavement. Each unit shall be self-cleaning and

self-contained, shall be able to confine dust and debris from the operation, and shall be capable of recycling the abrasive for reuse.

1.5.8 Traffic Controls

Traffic controls are not required. The Owner will close the Rest Stop with signage and barricades prior to this contract commencing, therefore no traffic controls are required beyond that provided by the Owner.

1.6 WEATHER LIMITATIONS FOR REMOVAL

Pavement surface shall be free of snow, ice, or slush. Surface temperature shall be at least 40 degrees F and rising at the beginning of operations, except those involving shot or sand blasting. Operation shall cease during thunderstorms. Operation shall cease during rainfall, except for waterblasting and removal of previously applied chemicals. Waterblasting shall cease where surface water accumulation alters the effectiveness of material removal.

1.7 QUALIFICATIONS

The Contractor shall submit documentation certifying that pertinent personnel are qualified for equipment operation and handling of chemicals.

PART 2 PRODUCTS

2.1 MATERIALS

Provide materials conforming to the requirements specified herein.

2.1.1 Paints for Roads and Streets

FS TT-P-1952, color as selected.

2.1.2 Reflective Media for Roads and Streets

FS TT-B-1325, Type I, Gradation A.

2.1.3 Thermoplastic Compounds

The thermoplastic reflectorized pavement marking compound shall be extruded or sprayed in a molten state onto a primed pavement surface. Following a surface application of glass beads and upon cooling to normal pavement temperatures, the marking shall be an adherent reflectorized strip of the specified thickness and width that is capable of resisting deformation by traffic.

2.1.3.1 Composition Requirements

The binder component shall be formulated as a hydrocarbon resin. The pigment, beads and filler shall be uniformly dispersed in the binder resin. The thermoplastic composition shall be free from all skins, dirt, and foreign objects and shall comply with the following requirements:

Percent by Weight

Component	White	Yellow
Binder	17 min	17 min

Titanium dioxide	10 min	-
Glass beads	20 min	20 min
Calcium carbonate and inert fillers	49 min	*
Yellow pigments	-	*

*Amount and type of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, providing the other composition requirements of this specification are met.

2.1.3.2 Physical Properties

a. Drying time: When installed at 70 degrees F and in thicknesses between 0.120 and 0.190 inch, the composition shall be completely solid and shall show no damaging effect from traffic after curing 15 minutes.

b. Softening point: The composition shall have a softening point of not less than 194 degrees F when tested in accordance with ASTM E 28.

c. Specific gravity: The specific gravity of the composition shall be between 1.9 and 2.2 as determined in accordance with ASTM D 792.

2.1.3.3 Primer

a. Asphalt concrete primer: The primer for asphalt concrete pavements shall be a thermosetting adhesive with a solids content of pigment reinforced synthetic rubber and synthetic plastic resin dissolved or dispersed in a volatile organic solvent. The solids content shall not be less than 10 percent by weight at 70 degrees F and 60 percent relative humidity. A wet film thickness of 0.005 inch, plus or minus 0.001 inch, shall dry to a tack-free condition in less than 5 minutes.

b. Portland cement concrete primer: The primer for portland cement concrete pavements shall be an epoxy resin primer. The primer shall be of the type recommended by the manufacturer of the thermoplastic composition.

2.1.4 PREFORMED TAPE

The preformed tape shall be an adherent reflectorized strip in accordance with ASTM D 4505 Type I or IV, Class optional.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Allow new pavement surfaces to cure for a period of not less than 30 days before application of marking materials. Thoroughly clean surfaces to be marked before application of the paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods as required. Remove rubber deposits, existing paint markings, residual curing compounds, and other coatings adhering to the pavement by water blasting. For Portland Cement Concrete pavement, grinding, light shot blasting, and light scarification, to a resulting profile equal to ICRI 03732 CSP 2, CSP 3, and CSP 4, respectively, can be used in addition to water blasting, to either remove existing coatings or for surface preparation on most pavements: shot

blasting shall not be used. Scrub affected areas, where oil or grease is present on old pavements to be marked, with several applications of trisodium phosphate solution or other approved detergent or degreaser and rinse thoroughly after each application. After cleaning oil-soaked areas, seal with shellac or primer recommended by the manufacturer to prevent bleeding through the new paint. Do not commence painting in any area until pavement surfaces are dry and clean.

3.2 APPLICATION

3.2.1 Testing for Moisture

Apply pavement markings to dry pavement only. The Contractor shall test the pavement surface for moisture before beginning work after each period of rainfall, fog, high humidity, or cleaning, or when the ambient temperature has fallen below the dew point. Do not commence marking until the pavement is sufficiently dry and the pavement condition has been approved by the Owner's Representative.

3.2.2 Rate of Application

3.2.2.1 Reflective Markings

Apply paint evenly to the pavement area to be coated at a rate of 105 plus or minus 5 square feet per gallon. Collect and record readings for white and yellow retroreflective markings at the rate of one reading per 1000 linear feet. The minimum acceptable average for white markings is 200 millicandelas per square meter per lux (mcd/m2/lx) (measured with Mirolux 12 Retroreflectometer or similar instrument as agreed). The minimum acceptable average for yellow markings is 175 millicandelas per square meter per lux (mcd/m2/lx). Readings shall be computed by averaging a minimum of 10 readings taken within the area at random locations. Areas not meeting the retroreflective requirements stated above shall be re-marked.

3.2.2.2 Thermoplastic Compound

After surface preparation has been completed, prime the asphalt or concrete pavement surface with spray equipment. Allow primer materials to "set-up" prior to applying the thermoplastic composition. Allow the asphalt concrete primer to dry to a tack-free condition, usually occurring in less than 10 minutes. Allow the Portland Cement concrete primer to dry in accordance with the thermoplastic manufacturer recommendations. To shorten the curing time of the epoxy resins, an infrared heating device may be used on the concrete primer. Apply asphalt concrete primer to all asphalt concrete pavements at a wet film thickness of 0.005 inch, plus or minus 0.001 inch 265 to 400 square feet per gallon. Apply portland cement concrete primer to all concrete pavements at a wet film thickness of between 0.04 to 0.05 inch 320 to 400 square feet per gallon. After the primer has "set-up", apply the thermoplastic at temperatures no lower than 375 degrees F nor higher than 425 degrees F at the point of deposition. Immediately after installation of the marking, apply drop-on reflective glass spheres mechanically at the rate of one pound per 20 square feet such that the spheres are held by and imbedded in the surface of the molten material. Apply all extruded thermoplastic markings at the specified width and at a thickness of not less than 0.125 inch nor more than 0.190 inch. Apply all sprayed thermoplastic markings at the specified width and the thickness designated in the contract plans. If the plans do not specify a thickness, apply centerline markings at a wet thickness of 0.090 inch, plus or minus

0.005 inch, and edgeline markings at a wet thickness of 0.060 inch, plus or minus 0.005 inch.

3.2.3 Painting

Apply paint pneumatically with approved equipment at rate of coverage specified herein. Provide guidelines and templates as necessary to control paint application. Take special precautions in marking numbers, letters, and symbols. Manually paint numbers, letters, and symbols. Sharply outline all edges of markings. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. Discontinue painting operations if there is a deficiency in drying of the markings until cause of the slow drying is determined and corrected.

3.2.4 Reflective Media

Application of reflective media shall immediately follow the application of paint. Accomplish drop-on application of the glass spheres to ensure even distribution at the specified rate of coverage. Should there be malfunction of either paint applicator or reflective media dispenser, discontinue operations until deficiency is corrected.

3.2.5 Thermoplastic Compound

Place thermoplastic pavement markings upon dry pavement. At the time of installation the pavement surface temperature shall be a minimum of 40 degrees F and rising. Thermoplastics, as placed, shall be free from dirt or tint. Apply all centerline, skipline, edgeline, and other longitudinal type markings with a mobile applicator. Place all special markings, crosswalks, stop bars, legends, arrows, and similar patterns with a portable applicator, using the extrusion method.

3.3 FIELD TESTING, INSPECTION, AND DEMONSTRATIONS

3.3.1 Sampling and Testing

As soon as the paint and reflective and thermoplastic materials are available for sampling, obtain by random selection from the sealed containers, two quart samples of each batch in the presence of the Contracting Officer. Accomplish adequate mixing prior to sampling to ensure a uniform, representative sample. A batch is defined as that quantity of material processed by the manufacturer at one time and identified by number on the label. Clearly identify samples by designated name, specification number, batch number, project contract number, intended use, and quantity involved. Test samples by an approved laboratory. If a sample fails to meet specification, replace the material in the area represented by the samples and retest the replacement material as specified above. Submit copy of the test results to the Owner's Representative. Include in the report of test results a listing of any specification requirements not verified by the test laboratory. At the discretion of the Owner's Representative, samples provided may be tested by the Government for verification.

3.3.2 Inspection

Examine material at the job site to determine that it is the material referenced in the report of test results or certificate of compliance. A certificate of compliance shall be accompanied by test results

substantiating conformance to the specified requirements.

3.3.3 Surface Preparations and Application Procedures

Surface preparations and application procedures will be examined by the Owner's Representative to determine conformance with the requirements specified. Approve each separate operation prior to initiation of subsequent operations.

3.4 TRAFFIC CONTROL AND PROTECTION

Traffic control are not required.

3.5 QUALITY ASSURANCE

Demonstrate success of bond of reflective media, new paint marking and the pavement surface, vacuum cured surface of new marking after a seven (7) day dry time. Inspect newly applied markings for signs of bond failure based on visual inspection and comparison to results from Test Stripe Demonstration paragraph.

3.5.1 Reflective Media and Coating Bond Verification

Within seven (7) days after pavement marking application, use industrial vacuum to sweep new markings. Visually inspect the pavement markings and the material captured by the vacuum. Verify that no significant loss of reflective media has occurred to the pavement marking due to the vacuum cleaning.

3.5.2 Reflective Media and Coating Application Verification

Use a wet film thickness gauge to measure the application of wet paint.

Use a microscope or magnifying glass to evaluate the embedment of glass beads in the paint. Verify the glass bead embedment with approximately 50% of the beads embedded and 50% of the beads exposed.

-- End of Section --

SECTION 02770

CONCRETE SIDEWALKS AND CURBS AND GUTTERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(2005) Burlap Cloth Made from Jute or Kenaf and Cotton Mats

ASTM INTERNATIONAL (ASTM)

ASTM A 185	(2001) Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 615/A 615M	(2000) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 143/C 143M	(2005) Slump of Hydraulic Cement Concrete
ASTM C 171	(2003) Sheet Materials for Curing Concrete
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 173/C 173M	(2001e1) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	(2004) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 309	(2003) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(1998) Making and Curing Concrete Test Specimens in the Field
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM D 1751	(2004) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004; Rev A) Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

ASTM D 5893	(2004) Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Concrete

Copies of certified delivery tickets for all concrete used in the construction.

Location(s) of product manufacture and of harvest/extraction/recovery of primary materials used in product. Designation of the percentages of post-consumer and pre-consumer recycled-content in cement and steel materials.

SD-06 Test Reports

Field Quality Control

Copies of all test reports within 24 hours of completion of the test.

1.3 WEATHER LIMITATIONS

1.3.1 Placing During Cold Weather

Concrete placement shall not take place when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.3.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 95 degrees F at any time.

1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.4.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Owner's Representative shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

PART 2 PRODUCTS

2.1 CONCRETE

Concrete shall conform to the applicable requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE except as otherwise specified. Concrete shall have a minimum compressive strength of 3500 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches.

2.1.1 Air Content

Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

The concrete slump shall be 4 inches plus or minus 1 inch without plastizens where determined in accordance with ASTM C 143/C 143M.

2.1.3 Reinforcement Steel

Reinforcement bars shall conform to ASTM A 615/A 615M. Wire mesh reinforcement shall conform to ASTM A 185. Reinforcement steel shall have a recycled content of 95 percent or more of which minimum 60 percent shall be post-consumer and the remainder may be pre-consumer. Reinforcement steel shall be manufactured and of primary materials extracted/harvested/recovered within a 500-mile radius of the project site.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C 309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.4.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 1/2 inch thick, unless otherwise indicated.

2.5 JOINT SEALANTS

Joint sealant, cold-applied shall conform to ASTM C 920 or ASTM D 5893.

2.6 FORM WORK

Form work shall be designed and constructed to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 10 feet. Radius bends may be formed with 3/4 inch boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 10 feet with a minimum of 3 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

2.6.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch

benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement.

3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Forms shall be set to the indicated alignment, grade and dimensions. Forms shall be held rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10 foot long section. After forms are set, grade and alignment shall be checked with a 10 foot straightedge. Forms shall have a transverse slope of 1/4 inch per foot with the low side adjacent to the roadway. Side forms shall not be removed for 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of

curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of 1/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".

3.4.2 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the

same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.4.3 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. Expansion joints are not required between sidewalks and curb that abut the sidewalk longitudinally.

3.5.1 Sidewalk Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 1/8 inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

Expansion joints shall be formed with 1/2 inch joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D 1752 or building paper. Joint filler shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with cold-applied joint sealant. Joint sealant shall be gray or stone in color. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.5.3 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length.

a. Contraction joints shall be constructed by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

3.6.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 1/2 inch in width shall be provided at intervals not less than 30 feet nor greater than 120 feet. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Expansion joints and the top 1 inch depth of curb and gutter contraction-joints shall be sealed with joint sealant. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period. Recycle or salvage waste steel, concrete and clean wood in accordance with Division 1 "Construction Waste Management" requirements.

3.7.1.1 Mat Method

The entire exposed surface shall be covered with 2 or more layers of burlap. Mats shall overlap each other at least 6 inches. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. The curing medium shall not be less than 18-inches wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet/gallon for the total of both coats. The second coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed.

3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.7.4 Application

Curing and backfilling operation shall be completed prior to applying two coats of protective coating. Concrete shall be surface dry and clean before each application. Coverage shall be by spray application at not more than 50 square yards/gallon for first application and not more than 70 square yards/gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture shall be in accordance with the manufacturer's instructions. Coated surfaces shall be protected from vehicular and pedestrian traffic until dry.

3.7.5 Precautions

Protective coating shall not be heated by direct application of flame or electrical heaters and shall be protected from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Material shall not be applied at ambient or material temperatures lower than 50 degrees F.

3.8 FIELD QUALITY CONTROL

3.8.1 General Requirements

The Contractor shall cooperate with the Owner's independant testing agent in the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

The Contractor shall cooperate with the Owner's independant testing agent in taking the molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 50 cubic yards of concrete. Strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31/C 31M by an approved testing laboratory.

3.8.2.2 Air Content

Air content shall be determined in accordance with ASTM C 173/C 173M or ASTM C 231. ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 50 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Owner and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

-- End of Section --

SECTION 02870

SITE FURNISHINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 611	(1998) Voluntary Specification for Anodized Architectural Aluminum; includes 604.2, 606.1, 607.1 and 608.1 (which are no longer available as separate documents)

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2000) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A10.3	(1995) Operations -- Safety Requirements for Powder Actuated Fastening Systems
ANSI B18.2.1	(1996; Errata 2003) Square and Hex Bolts and Screws Inch Series

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2004) Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.2.2	(1987; R 1999) Square and Hex Nuts
ASME B18.21.1	(1999) Lock Washers (Inch Series)
ASME B18.22.1	(1965; R 2003) Plain Washers
ASME B18.6.2	(1998) Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series (B18.6.2)
ASME B18.6.3	(1999) Machine Screws and Machine Screw Nuts

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(1997e1) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153/A 153M	(2004) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 185	(2001) Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 307	(2000) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 36/A 36M	(2000) Carbon Structural Steel
ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 48/A 48M	(2003) Gray Iron Castings
ASTM A 500	(2003a) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(2001) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 53/A 53M	(2004a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 615/A 615M	(2000) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 653/A 653M	(2001a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 780	(2001) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM B 108	(2003a) Aluminum-Alloy Permanent Mold Castings
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2004a) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 26/B 26M	(2003) Aluminum-Alloy Sand Castings
ASTM C 150	(1999a) Portland Cement
ASTM C 260	(2001) Air-Entraining Admixtures for Concrete
ASTM C 33	(2001a) Concrete Aggregates
ASTM C 94/C 94M	(2000) Ready-Mixed Concrete
ASTM C 979	(1999) Pigments for Integrally Colored Concrete

ASTM D 1187	(1997; R 2002e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM D 2990	(2001) Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
ASTM D 3451	(2001) Testing Coating Powders and Powder Coatings
ASTM D 4060	(2001) Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D 648	(2004) Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
ASTM E 488	(1996; R 2003) Strength of Anchors in Concrete and Masonry Elements

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 25	(1997; R 2000) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-1925	(Rev A; Notice 1) Shield, Expansion (Nail Anchors)

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Benches and Chairs
Tables
Bollards
Assembly Assembly Instruction Drawings

Drawings showing scaled details of proposed site furnishings, elevations for each type of site furnishing; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction.

SD-03 Product Data

Benches and Chairs
Tables
Bollards
Waste Receptacles

Manufacturer's descriptive data and catalog cuts.

Location(s) of product manufacture and of harvest/extraction/recovery of primary materials used in product.

SD-06 Test Reports

Recycled Materials

A report of site furnishing parts consisting of recycled materials. Product specification data, providing test information for deflection and creep in accordance with ASTM D 648 and ASTM D 2990 for site furnishings which use plastic lumber as a component, shall be submitted. The data shall provide a comparison of deflection and creep measurements to other comparable materials.

Testing

A report of post-installation test results.

SD-07 Certificates

Primer certificate
Powder coatings certificate

Manufacturer's certificate of compliance.

1.3 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M using procedures, materials, and equipment of the type required for the work.

1.4 DELIVERY, INSPECTION, STORAGE AND PROTECTION

Materials shall be delivered, handled, and stored in accordance with the manufacturer's recommendations. Site furnishings shall be inspected upon arrival at the job site for conformity to specifications and quality in accordance with paragraph MATERIALS. Protect from corrosion, staining, and other types of damage. Store items in designated area free from contact with soil and weather. Remove and replace damaged items with new items.

1.5 GENERAL REQUIREMENTS

1.5.1 Fabrication Drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

11.5.2 Installation Drawings

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation.

1.5.3 Assembly Instruction Drawings

Submit assembly instruction drawings showing layout(s), connections, bolting and anchoring details as per manufacturer's standards.

1.5.4 Primer Certificate

Submit a certificate from the manufacturer stating that the primer conforms to requirements of SSPC Paint 25.

1.5.5 Powder Coatings Certificate

Submit a certificate from the manufacturer stating that the powder coat conforms to ASTM D 3451.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall be the standard products of a manufacturer regularly engaged in the manufacture of such products. The materials provided shall be of a type with proven satisfactory usage for at least 2 years. Materials manufactured and of primary raw materials harvested/extraction/recovered within a 500-mile radius of the Project Site shall be given preference.

2.1.1 Metals

Metal components shall be furnished with factory drilled holes. Components shall be free of excess weld and spatter. Metal components with holes that will not be filled by hardware or hidden by other components will be rejected. Structural steel products shall conform to ASTM A 36/A 36M, ASTM A 500 and ASTM A 501. Steel components shall have a recycled content of 25 percent or more.

2.1.2 Structural Tubing

ASTM A 500.

2.1.3 Steel Pipe and Fittings

Steel pipe shall conform to ASTM A 53/A 53M, Type E or S, Grade B; standard malleable iron fittings shall conform to ASTM A 47/A 47M.

2.1.4 Gray Cast Iron

Gray cast iron shall conform to ASTM A 48/A 48M Class 35 or better. The Contractor shall provide castings manufactured true to pattern and component parts that fit together in a satisfactory manner. Castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. Smooth castings shall be well-cleaned by sand or shot blasting.

2.1.5 Cast Aluminum

Cast aluminum shall conform to ASTM B 26/B 26M and ASTM B 108. The Contractor shall provide castings manufactured true to pattern and component parts that fit together in a satisfactory manner. Castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. Smooth castings shall be well-cleaned by sand or shot blasting.

2.1.6 Aluminum Alloy Products

Conform to ASTM B 209 for sheet plate, ASTM B 221 for extrusions and ASTM B 26/B 26M or ASTM B 108 for castings, as applicable. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

2.1.7 Anchors and Hardware

Anchors shall be provided, where necessary, for fastening site furnishings securely in place and in accordance with approved manufacturer's instructions. Anchoring devices that may be used, when no anchors are otherwise specified or indicated, include anchor bolts, slotted inserts, expansion shields for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; and lag bolts and screws for wood. Anchor bolts shall conform to ASTM A 307. Hardware shall be stainless steel and compatible with the material to which applied. All exposed hardware shall match in color and finish. Mounting hardware shall be concealed, recessed, and plugged.

2.1.7.1 Threaded Inserts and Expansion Anchors

Provide inserts recessed not less than 2.5 inches into concrete or masonry. Pullout 198 pounds in concrete, as tested per ASTM E 488. Expansion shields shall conform to FS A-A-1925, group II, type 4, class 1. Provide embeddment required by manufacturer.

2.1.7.2 Lag Screws and Bolts

ANSI B18.2.1, type and grade best suited for the purpose.

2.1.7.3 Toggle Bolts

ANSI B18.2.1.

2.1.7.4 Bolts, Nuts, Studs and Rivets

ASME B18.2.2 or ASTM A 307.

2.1.7.5 Power Driven Fasteners

Follow safety provisions of ANSI A10.3.

2.1.7.6 Screws

ANSI B18.2.1, ASME B18.6.2, and ASME B18.6.3.

2.1.7.7 Washers

Provide plain washers to conform to ASME B18.22.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ASME B18.21.1.

2.1.8 Concrete

Ready-mixed concrete shall conform to ASTM C 94/C 94M, using 3/4 inch maximum size aggregate, and having minimum compressive strength of 3000 psi at 28 days. Portland cement shall conform to ASTM C 150. Cast-in-place concrete materials and products shall conform to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Reinforcing steel shall conform to ASTM A 615/A 615M. Welded wire fabric shall conform to ASTM A 185.

2.1.9 Plastics

Recycled materials shall contain a minimum 85 percent recycled

post-consumer product. Recycled materials shall be constructed or manufactured with a maximum 1/4 inch deflection or creep in any member in conformance with ASTM D 648 and ASTM D 2990. The Contractor shall provide panels and components molded of ultraviolet (UV) and color stabilized polyethylene, with minimum 1/4 inch wall thickness; exposed edges shall be smoothed, rounded, and free of burrs and points; and the material shall be resistant to fading, cracking, fogging, and shattering. The material shall be non-toxic and have no discernible contaminates such as paper, foil, or wood. The material shall contain no more than 3 percent air voids. Material shall be resistant to deformation from solar radiation heat gain. Recycled materials to include plastic lumber will not be used as structural components of site furnishings.

2.1.10 Fiberglass

Fiberglass shall consist of at least 3 laminations of chopped glass fibers impregnated with polyester resin, with colors and textures molded into all exposed surfaces so that colors resist fading. Fiberglass shall be resistant to cleaners, fertilizers, high power spray and salt.

2.2 PRETREATMENT, PRIMING AND PAINTING

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

2.2.1 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.2 Aluminum Surfaces

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.3 COATINGS AND FINISHES

2.3.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing shall conform to ASTM A 123/A 123M, ASTM A 153/A 153M or ASTM A 653/A 653M, as applicable. Tailings and sharp protrusions formed as a result of the hot-dip process shall be removed and exposed edges burnished. Galvanize anchor bolts, grating fasteners, washers and parts or devices necessary for proper installation, unless otherwise indicated.

2.3.2 Polyester Powder

Powder-coated surfaces shall receive electrostatic zinc coating prior to painting. Powder coating shall be electrostatically applied and oven cured. Polyester powder coating shall be resistant to ultraviolet (UV) light.

2.3.3 Polyvinyl-Chloride (PVC)

PVC coating shall be primed with a clear acrylic thermosetting solution. The primed parts shall be preheated prior to dipping. The liquid polyvinyl chloride shall be ultraviolet (UV) stabilized and mold-resistant. The coated parts shall be cured. The coating shall be a minimum 2/25 inches thick plus or minus 0.020 inches and shall have an 85 durometer hardness with a slip-resistant finish.

2.3.4 Finish

Finish shall be as specified by the manufacturer or as indicated. Exposed surfaces and edges shall be rounded, polished, or sanded. Finish shall be non-toxic, non-glare, and resistant to corrosion. Exposed surfaces shall be smooth and splinter-free exposed surfaces.

2.3.4.1 Paint

Paint shall be factory applied with a minimum of 2 coats. Paint shall be weather-resistant and resistant to cracking, peeling and fading.

2.3.4.2 Color

Color of site furnishing components shall be in accordance with Plans.

2.4 BENCHES AND CHAIRS

Benches and chairs shall be furnished with no sharp edges or protruding hardware.

a. Height: The height above finished grade or specified surface shall be between 18-20 inches and level.

b. Seat: The seat surface shall be pitched or slotted to shed water; the seat depth shall be between 12-18 inches and pitched down at the back at a 0-5 degree angle. Seat shall have a minimum width of 24 inches per person, and shall overhang the support base by a minimum of 4 inches for heel space and to facilitate rising from a seating position.

c. Back Rest: When back rests are required, the height shall be between 15-18 inches from the top of the seat and the connection shall be at a 90-110 degree angle to the seat.

d. Arm Rest: When arm rests are required, a minimum of 6 inches height from the seat and a minimum arm rest width of 1-1/2 inches shall be provided.

e. Weight Limit: Seats shall support a minimum 300 lbs for each person they are designed to accommodate.

2.4.1 Support Pedestals

Provide support pedestals as per manufacturer's standard.

a. Cast grey iron: ASTM A 48/A 48M Class 30 or recycled cast grey iron ASTM A 48/A 48M Class 25.

b. Cast aluminum: ASTM B 26/B 26M or ASTM B 108 as applicable.

c. Steel: ASTM A 653/A 653M.

d. Design fiberglass pedestals to support the loads imposed in design of bench. Color as approved.

2.4.2 Steel Arms

Provide 3/8 inch thick by 3 inch wide steel bench arms conforming to ASTM A 653/A 653M.

2.4.3 Fiberglass Benches

Provide reinforced fiberglass benches molded with multiple laminations of glass fiber impregnated with polyester isophthalic thermosetting resins, minimum thickness of 1/8 inch and reinforced as per manufacturer's standard practice.

a. Design bench to sustain a live load of not less than 200 pounds per square foot.

b. Provide manufacturer's finish, 12-15 mil color impregnated polyester gel coat, of color as selected from manufacturer's standard colors and finishes, smooth matte.

2.4.4 Steel Units

2.4.4.1 Perforated Steel

Provide 14 gage perforated steel sheet, electrostatically coated with two component polyester enamel.

a. Design bench to sustain a live load of not less than 200 pounds per square foot.

b. Provide 1-1/2 inch O.D. ASTM A 53/A 53M schedule 40 steel pipe pedestals.

2.4.5 Aluminum Units

AAMA 611. Provide extruded or formed aluminum benches as per manufacturers standard, with powder coat finish, color as selected from manufacturer's standards.

a. Design benches to sustain a live load of not less than 200 pounds per square foot.

b. Provide manufacturer's standard cast aluminum pedestals.

2.4.6 Accessoriess

Provide manufacturer's standard materials and accessories as required for assembly of units and as indicated on the assembly drawings. Provide unexposed aluminum, stainless steel or steel plates, angles and supports as required for complete assembly. Separate dissimilar materials to prevent electrolytic action.

2.4.7 Fasteners

Provide concealed fasteners except where specifically approved; types as required for specific usage.

2.4.8 Anchoring Brackets

Provide 1/4 inch zinc plated steel angle anchoring brackets, 1-7/8 inch wide by 2 inches deep by 2-1/2 inches high, pre-drilled for bolting benches to substrate.

2.5 BOLLARDS

2.5.1 Precast Concrete Bollards

Provide reinforced concrete bollards as indicated on the plans, suitable for ground mount installation. Provide exposed aggregate or sandblast finish as indicated; manufacturer's standard clear acrylic sealer.

a. Portland cement: ASTM C 150 Type I II or III.

b. Aggregate: ASTM C 33, maximum size 3/4 inch.

c. Reinforcing steel: ASTM A 615/A 615M.

d. Integral color: ASTM C 979, pure mineral oxide, limeproof and non-fading.

e. Concrete strength: 5000 psi, 28 day minimum compressive strength.

f. Admixture: ASTM C 260 for air-entraining.

2.6 WASTE RECEPTACLES and ASH RECEPTACLES

Provide waste receptacles as indicated on the plans. Waste receptacles shall be furnished with weather protection, odor containment, and insect/animal-proofing. Container size shall be as directed.

a. Height: Trash and litter deposit openings shall be between 30-40 inches above the ground.

b. Liners: Trash and litter receptacles shall be furnished with disposable inner-linings. Self-dumping type designs to include hinged bottom, top or sides will be rejected.

c. Anchors: Trash and litter receptacles that can be anchored to resist overturning by typical use, high winds, or animals shall be furnished and anchored in accordance with the manufacturer's recommendations.

d. Openings: Openings for trash and litter insertion shall be a minimum of 4 inches in diameter. Edges of the openings shall be crimped, rounded and smoothed.

e. Ash Receptacles: The Contractor shall provide ash receptacles with a fire-proof metal bowl or screen or sand-filled containers for ash containment. Ash receptacles shall have easily removable liners for cleaning.

2.6.1 Finishes

Provide factory finished units with manufacturer's standard texture or sandblasted finish as selected.

a. Color: ASTM C 979, pure, non-fading mineral oxides which do not impair strength of GFRC; designed and mixed to provide color matching approved samples; maximum 10 percent cement weight.

b. Applied Finishes: ASTM D 4060 waterborne crosslinked acrylic 49.5 +/-2 percent solids by weight providing 1000 cycles per 0.001 inch resistance to abrasion.

2.6.2 Fiberglass Waste Receptacles Ash Receptacles

Provide reinforced fiberglass waste receptacles and ash receptacles molded with multiple laminations of glass fiber impregnated with polyester isophthalic thermosetting resins; with 12-15 mil color impregnated polyester gel coat finish; minimum thickness of 1/4 inch; color as selected.

PART 3 EXECUTION

3.1 INSTALLATION

The Contractor shall verify that finished grades and other operations affecting mounting surfaces have been completed prior to the installation of site furnishings. Site furnishings shall be installed plumb and true, at locations indicated,in accordance with the approved manufacturer's instructions.

3.1.1 Assembly and Erection of Components

Items shall be shipped knocked-down (KD) ready for site assembly. Packaged components shall be complete including all accessories and hardware. New parts shall be acquired from the manufacturer; substitute parts will not be accepted unless approved by the manufacturer. When the inspection of parts has been completed, the site furnishings shall be assembled and anchored according to manufacturer's instructions or as indicated. When site furnishings are assembled at the site, assembly shall not interfere with other operations or pedestrian and vehicular circulation.

3.1.2 Anchorage, Fastenings, and Connections

Furnish metal work, mounting bolts or hardware in ample time for securing into concrete or masonry as the work progresses. Provide anchorage where necessary for fastening furniture or furnishings securely in place. Provide, for anchorage not otherwise specified or indicated, slotted inserts, expansion shields, and power-driven fasteners, when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish the fastenings to which they are applied. Conceal fastenings where practicable.

3.2 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections.

Grind visible welds smooth in the finished installation.

3.3 TESTING

Each site furnishing shall be tested to determine a secure and correct installation. A correct installation shall be according to the manufacturer's recommendations and by the following procedure: The Contractor shall measure the physical dimensions and clearance of each installed site furnishing for compliance with manufacturer's recommendations and as indicated. Site furnishings which do not comply shall be reinstalled. Fasteners and anchors determined to be non-compliant shall be replaced. A written report describing the results of the testing shall be provided.

3.4 FINISHES

3.4.1 Field Finishes

Where indicated, field finishes shall be applied in accordance with Section 09900 PAINTS AND COATINGS. Where dissimilar metals are in contact, protect surfaces with a coat conforming to SSPC Paint 25 to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, mortar, masonry, or absorptive materials subject to wetting, protect with ASTM D 1187, asphalt-base emulsion.

3.4.2 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A 780 or by the application of stick or thick paste material specifically designed for repair of galvanizing, as approved by the Contracting Officer. Clean areas to be repaired and remove the slag from the welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread the molten material uniformly over surfaces to be coated and wipe the excess material off.

3.5 BOLLARDS

Install in pipe sleeves embedded in concrete and filled with non-shrink grout or quick setting anchoring cement.

3.6 RESTORATION AND CLEAN UP

When the installation has been completed, the Contractor shall clean up and protect the site. Existing areas that have been damaged from the installation operation shall be restored to original condition at Contractor's expense.

3.6.1 Clean Up

The site shall be cleaned of all materials associated with the installation. Site furnishing surfaces shall be cleaned of dirt, stains, filings, and other blemishes occurring from shipment and installation. Cleaning methods and agents shall be according to manufacturer's instructions or as indicated.

3.6.2 Protection

The area shall be protected as required or directed by providing barricades

and signage.

3.6.3 Disposal of Materials

Recycle or salvage waste steel, concrete and clean wood in accordance with Division 1 "Construction Waste Management" requirements.

3.7 RE-INSTALLATION

Where re-installation is required, the following shall be accomplished:

a. Re-install the product as specified. Material acquisition of replacement parts is the responsibility of the Contractor. Provide replacement materials that are new and supplied by the original manufacturer to match.

b. Damage caused by the failed installation shall be repaired.

-- End of Section --

SECTION 02921

SEEDING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 602	(1995a; R 2001) Agricultural Liming Materials
ASTM D 4427	(1992; R 2002e1) Peat Samples by Laboratory Testing
ASTM D 4972	(2001) pH of Soils

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act	(1940; R 1988; R 1998) Federal Seed Act
DOA SSIR 42	(1996) Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 3.0

1.2 DEFINITIONS

1.2.1 Stand of Turf

95 percent ground cover of the established species.

1.3 RELATED REQUIREMENTS

Section 02315 Excavation, Filling and Backfilling, Section 02930 EXTERIOR PLANTS, and Section 02935 LANDSCAPE ESTABLISHMENT applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Wood cellulose fiber mulch

Fertilizer

Include physical characteristics, and recommendations.

Location(s) of product manufacture and of

harvest/extraction/recovery of primary materials used in product.

SD-06 Test Reports

Topsoil composition tests (reports and recommendations).

SD-07 Certificates

State certification and approval for seed

SD-08 Manufacturer's Instructions

Erosion Control Materials

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Seed Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.5.1.2 Fertilizer, Gypsum, Sulfur, Iron, and Lime Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer, gypsum, sulphur, iron, and lime may be furnished in bulk with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Seed, Fertilizer, Gypsum, Sulfur, Iron, and Lime Storage

Store in cool, dry locations away from contaminants.

1.5.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.5.2.3 Handling

Do not drop or dump materials from vehicles.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when the ground is frozen, snow covered, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.7 TIME LIMITATIONS

1.7.1 Seed

Apply seed within twenty four hours after seed bed preparation.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Classification

Provide State-certified, State-approved, Endophyte-enhanced seed of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weedseed content, and inert material. Label in conformance with AMS Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected. Field mixes will be acceptable when field mix is performed on site in the presence of the Owner's Representative. Materials shall be manufactured and harvested/extracted/recovered within a 500-mile radius of the Project Site.

2.1.2 Planting Dates

Planting Season	Planting Dates
Season 1	May 1 to July 1
Season 2	September 1 to October 15
Temporary Seeding	Anytime

2.1.3 Seed Mixture by Weight

Proportion seed mixture by weight basis.

Seed Mixture #1 - full sun to partial shade: 90% seeded tall Fescue varieties and 10% Kentucky Bluegrass varieties.

90% Tall Fescue Varieties Approved for Use: Barrerra, Coyote, Dominion, Endeavor, Falcon ii, Good-en, Houndog 5, Jaguar 3, Laramie, Masterpiece, Olympic Gold, Plantation, Rebel Sentry, Watchdog, and Wolfpack.

10% Kentucky Bluegrass Varieties Approved for Use: Abbey, Baron, and Wildwood.

Seed mixture #2 - full shade: 65% seeded Kentucky Bluegrass and 35% shade tolerant Kentucky Bluegrass varieties.

65% Seeded Kentucky Bluegrass Varieties Approved for Use: Apollo, award, Baronie, Blackstone, Brilliant, Coventry, Envicta, Fairfax, Jefferson, Liberator, Midnight, North Star, Rambo, Shamrock, and Washington.

35% Shade Tolerant Kentucky Bluegrass Varieties Approved for Use: Ascot, Brilliant, Champagne, Liberator, Quantum Leap, and Showcase.

Temporary seeding must later be replaced by season 1 or season 2 plantings for a permanent stand of grass. The same requirements of turf establishment for season 1 or season 2 apply for temporary seeding. Conform to requirements specified in paragraph entitled "broadcast and drop seeding" and "hydroseeding" for application rates for temporary and permanent seeding

2.2 TOPSOIL

2.2.1 On-Site Topsoil

Surface soil stripped and stockpiled on site and modified as necessary to meet the requirements specified for topsoil in paragraph entitled "Composition." When available topsoil shall be existing surface soil stripped and stockpiled on-site in accordance with Section02315 EXCAVATION AND FILLING AND BACKFILL.

2.2.2 Off-Site Topsoil

Conform to requirements specified in paragraph entitled "Composition." Additional topsoil shall be furnished by the Contractor.

2.2.3 Composition

Containing from 5 to 10 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42. Maximum particle size, 3/4 inch, with maximum 3 percent retained on 1/4 inch screen. The pH shall be tested in accordance with ASTM D 4972. Topsoil shall be free of sticks, stones, roots, and other debris and objectionable materials. Other components shall conform to the following limits:

Silt	25-50 Percent
Clay	10-30 Percent
Sand	20-35 Percent
pH	5.5 to 7.0
Soluble Salts	600 ppm maximum

Materials shall be manufactured and harvested/extracted/recovered within a 500-mile radius of the Project Site.

2.3 SOIL CONDITIONERS

Add conditioners to topsoil as required to bring into compliance with "composition" standard for topsoil as specified herein.

2.3.1 Lime

Commercial grade hydrate or burnt limestone containing a calcium carbonate equivalent (C.C.E.) as specified in ASTM C 602 of not less than 50 percent.

2.3.2 Aluminum Sulfate

Commercial grade.

2.3.3 Sulfur

100 percent elemental

2.3.4 Iron

100 percent elemental

2.3.5 Peat

Natural product of peat moss derived from a freshwater site and conforming

to ASTM D 4427 as modified herein. Shred and granulate peat to pass a 1/2 inch mesh screen and condition in storage pile for minimum 6 months after excavation.

2.3.6 Sand

Clean and free of materials harmful to plants.

2.3.7 Perlite

Horticultural grade.

2.3.8 Composted Derivatives

Ground bark, nitrolized sawdust, humus or other green wood waste material free of stones, sticks, and soil stabilized with nitrogen and having the following properties:

2.3.8.1 Particle Size

Minimum percent by weight passing:

No. 4 mesh screen	95
No. 8 mesh screen	80

2.3.8.2 Nitrogen Content

Minimum percent based on dry weight:

Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.3.9 Gypsum

Coarsely ground gypsum comprised of calcium sulfate dihydrate 91 percent, calcium 22 percent, sulfur 17 percent; minimum 96 percent passing through 20 mesh screen, 100 percent passing thru 16 mesh screen.

2.3.10 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 1200 degrees F. Gradation: A minimum 90 percent shall pass a No. 8 sieve; a minimum 99 percent shall be retained on a No. 60 sieve; and a maximum 2 percent shall pass a No. 100 sieve. Bulk density: A maximum 40 pounds per cubic foot.

2.4 FERTILIZER

2.4.1 Granular Fertilizer

Synthetic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

16 percent available nitrogen
7 percent available phosphorus
12 percent available potassium
2 percent iron

2.4.2 Hydroseeding Fertilizer

Controlled release fertilizer, to use with hydroseeding and composed of pills coated with plastic resin to provide a continuous release of nutrients for at least 6 months and containing the following minimum percentages, by weight, of plant food nutrients.

16 percent available nitrogen
7 percent available phosphorus
12 percent available potassium
2 percent iron

2.5 MULCH

Mulch shall be free from noxious weeds, mold, and other deleterious materials. Materials shall be manufactured and harvested/extracted/recovered within a 500-mile radius of the Project Site.

2.5.1 Straw

Stalks from oats, wheat, rye, barley, or rice. Furnish in air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Straw shall contrain no fertile seed.

2.5.2 Hay

Air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Hay shall be sterile, containing no fertile seed.

2.5.3 Wood Cellulose Fiber Mulch

Use recovered materials of either paper-based (100 percent) or wood-based (100 percent) hydraulic mulch. Processed to contain no growth or germination-inhibiting factors and dyed an appropriate color to facilitate visual metering of materials application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 5.5 to 8.2. Use with hydraulic application of grass seed and fertilizer.

2.6 WATER

Source of water shall be approved by Owner's Representative and of suitable quality for irrigation, containing no elements toxic to plant life.

2.7 EROSION CONTROL MATERIALS

Erosion control material shall conform to the following:

2.7.1 Erosion Control Blanket

70 percent agricultural staw/30 percent coconut fiber matrix stitched with a degradable nettings, designed to degrade within 12 months.

2.7.2 Erosion Control Fabric

Fabric shall be knitted construction of polypropylene yarn with uniform mesh openings 3/4 to 1 inch square with strips of biodegradable paper. Filler paper strips shall have a minimum life of 6 months.

2.7.3 Erosion Control Net

Net shall be heavy, twisted jute mesh, weighing approximately 1.22 pounds per linear yard and 4 feet wide with mesh openings of approximately 1 inch square.

2.7.4 Hydrophilic Colloids

Hydrophilic colloids shall be physiologically harmless to plant and animal life without phytotoxic agents. Colloids shall be naturally occurring, silicate powder based, and shall form a water insoluble membrane after curing. Colloids shall resist mold growth.

2.7.5 Erosion Control Material Anchors

Erosion control anchors shall be as recommended by the manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 EXTENT OF WORK

Provide soil preparation (including soil conditioners as required), fertilizing, seeding, and surface topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.1.1 Topsoil

Provide 4 inches of topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer, pH adjusters & soil conditioners into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Contracting Officer. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.1.1.2 Soil Conditioner Application Rates

Apply soil conditioners at rates as determined by laboratory soil analysis of the soils at the job site.

3.1.1.3 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site.

3.2 SEEDING

3.2.1 Seed Application Seasons and Conditions

Immediately before seeding, restore soil to proper grade. Do not seed when ground is muddy, frozen, snow covered or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Owner's Representative stating the special conditions and proposed variance. Apply

seed within twenty four hours after seedbed preparation. Sow seed by approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.

3.2.2 Seed Application Method

Seeding method shall be broadcasted and drop seeding or hydroseeding.

3.2.2.1 Broadcast and Drop Seeding

Seed shall be uniformly broadcast at the rate of 91 kg. per acre. Use broadcast or drop seeders. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing. Cover seed uniformly to a maximum depth of 1/4 inch in clay soils and 1/2 inch in sandy soils by means of spike-tooth harrow, cultipacker, raking or other approved devices.

3.2.2.2 Hydroseeding

First, mix water and fiber. Wood cellulose fiber, paper fiber, or recycled paper shall be applied as part of the hydroseeding operation. Fiber shall be added at 1,000 pounds, dry weight, per acre. Then add and mix seed and fertilizer to produce a homogeneous slurry. Seed shall be mixed to ensure broadcasting at the rate of 91 kg per acre. When hydraulically sprayed on the ground, material shall form a blotter like cover impregnated uniformly with grass seed. Spread with one application with no second application of mulch.

3.2.3 Mulching

3.2.3.1 Hay or Straw Mulch

Hay or straw mulch shall be spread uniformly at the rate of 2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader, or other approved method. Mulching shall be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All areas installed with seed shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading.

3.2.4 Erosion Control Material

Install in accordance with manufacturer's instructions, where indicated or as directed by the Owner's Representative.

3.2.5 Watering

Start watering areas seeded as required by temperature and wind conditions. Apply water at a rate sufficient to insure thorough wetting of soil to a depth of 2 without run off. During the germination process, seed is to be kept actively growing and not allowed to dry out.

3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

3.4 RENOVATION OF EXISTING TURF AREA

3.4.1 Aeration

Upon completion of weed eradication operations and Owner's Representative approval to proceed, aerate turf areas indicated , by approved device. Core, by pulling soil plugs, to a minimum depth of 2 inches. Leave all soil plugs, that are produced, in the turf area. Remove all debris generated during this operation off site. After aeration operations are complete, topdress entire area 1/2 inch depth with topsoil meeting specifications.

Blend all parts of topdressing mixture to a uniform consistency throughout. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean all soil plugs off of other paving when work is complete.

3.4.2 Overseeding

Apply seed in accordance with applicable portions of paragraph entitled "Seed Application Method" at rates in accordance with paragraph entitled "Seed Composition."

3.5 RESTORATION

Restore to original condition existing turf areas which have been damaged during turf installation operations at the Contractor's expense. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

-- End of Section --

SECTION 02930

EXTERIOR PLANTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A300	(1995) Tree Care Operations - Trees, Shrubs and Other Woody Plant Maintenance
ANSI Z133.1	(2001) Arboricultural Operations -- Safety Requirements for Pruning, Repairing, Maintaining, and Removing Trees, and Cutting Brush
ANSI Z60.1	(1996) Nursery Stock

ASTM INTERNATIONAL (ASTM)

ASTM A 580/A 580M	(1998; R 2004) Stainless Steel Wire
ASTM C 602	(1995a; R 2001) Agricultural Liming Materials
ASTM D 4427	(1992; R 2002e1) Peat Samples by Laboratory Testing
ASTM D 4972	(2001) pH of Soils

L.H. BAILEY HORTORIUM (LHBH)

LHBH	(1976) Hortus Third

U.S. DEPARTMENT OF AGRICULTURE (USDA)

DOA SSIR 42	(1996) Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 3.0

1.2 RELATED REQUIREMENTS

Section 02315 Excavation, Filling and Backfilling, Section 02921 SEEDING, and Section 02935 LANDSCAPE ESTABLISHMENT applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

State Landscape Contractor's License

SD-03 Product Data

Mulch

Fertilizer

Weed control fabric

Root control barrier

Metal edging

Metal anchors

Antidesiccants

Erosion control materials

Location(s) of product manufacture and of harvest/extraction/recovery of primary materials used in products.

SD-06 Test Reports

Topsoil composition tests

SD-07 Certificates

Nursery certifications

Indicate names of plants in accordance with the LHBH, including type, quality, and size.

1.4 QUALITY ASSURANCE

1.4.1 Topsoil Composition Tests

Commercial test from an independent testing laboratory including basic soil groups (moisture and saturation percentages, Nitrogen-Phosphorus-Potassium (N-P-K) ratio, pH (ASTM D 4972), soil salinity), secondary nutrient groups (calcium, magnesium, sodium, Sodium Absorption Ratio (SAR)), micronutrients (zinc, manganese, iron, copper), toxic soil elements (boron, chloride, sulfate), cation exchange and base saturation percentages, and soil amendment and fertilizer recommendations with quantities for plant material being transplanted. Soil required for each test shall include a maximum depth of 18 inches of approximately 1 quart volume for each test. Areas sampled should not be larger than 1 acre and should contain at least 6-8 cores for each sample area and be thoroughly mixed. Problem areas should be sampled separately and compared with samples taken from adjacent non-problem areas. The location of the sample areas should be noted and marked on a parcel or planting map for future reference.

1.4.2 Nursery Certifications

a. Indicate on nursery letterhead the name of plants in

accordance with the LHBH, including botanical common names, quality, and size.

b. Inspection certificate.

c. Mycorrhizal fungi inoculum for plant material treated

1.4.3 State Landscape Contractor's License

Construction company shall hold a landscape contractors license in the state where the work is performed and have a minimum of five years landscape construction experience. Submit copy of license and three references for similar work completed in the last five years.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Branched Plant Delivery

Deliver with branches tied and exposed branches covered with material which allows air circulation. Prevent damage to branches, trunks, root systems, and root balls and desiccation of leaves.

1.5.1.2 Soil Amendment Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, or trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer, gypsum, sulfur, iron, and lime may be furnished in bulk with a certificate indicating the above information. Store in dry locations away from contaminates.

1.5.1.3 Plant Labels

Deliver plants with durable waterproof labels in weather-resistant ink. Provide labels stating the correct botanical plant name and variety as applicable and size as specified in the list of required plants. Attach to plants, bundles, and containers of plants. Groups of plants may be labeled by tagging one plant. Labels shall be legible for a minimum of 60 days after delivery to the planting site.

1.5.2 Storage

1.5.2.1 Plant Storage and Protection

Store and protect plants not planted on the day of arrival at the site as follows:

a. Shade and protect plants in outside storage areas from the wind and direct sunlight until planted.

b. Heel-in bare root plants.

c. Protect balled and burlapped plants from freezing or drying out by covering the balls or roots with moist burlap, sawdust, wood chips, shredded bark, peat moss, or other approved material. Provide covering which allows air circulation.

d. Keep plants in a moist condition until planted by watering with a fine mist spray.

e. Do not store plant material directly on concrete or bituminous surfaces.

1.5.2.2 Fertilizer, Gypsum, pH Adjusters, and Mulch Storage

Store in dry locations away from contaminants.

1.5.2.3 Topsoil

Prior to stockpiling topsoil, eradicate on site undesirable growing vegetation. Clear and grub existing vegetation three to four weeks prior to stockpiling existing topsoil.

1.5.2.4 Root Control Barrier and Weed Control Fabric

Store materials on site in enclosures or under protective covering in dry location. Store under cover out of direct sunlight. Do not store materials directly on ground.

1.5.3 Handling

Do not drop or dump plants from vehicles. Avoid damaging plants being moved from nursery or storage area to planting site. Handle boxed balled and burlapped, balled and potted, processed balled, in-ground fabric bag grown, container plants carefully to avoid damaging or breaking the earth ball or root structure. Do not handle plants by the trunk or stem. Remove damaged plants from the site.

1.5.4 TIME LIMITATION

Except for container-grown plant material, the time limitation from digging to installing plant material shall be a maximum of 90 days. The time limitation between installing the plant material and placing the mulch shall be a maximum of 24 hours.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when ground is frozen, snow covered, muddy, or when air temperature exceeds 90 degrees Fahrenheit

1.7 GUARANTEE

All plants shall be guaranteed for one year beginning on the date of inspection by the Owner's Representative to commence the plant establishment period. Transplanted plants require no guarantee.

PART 2 PRODUCTS

2.1 PLANTS

2.1.1 Regulations and Varieties

Furnish nursery stock in accordance with ANSI Z60.1, except as otherwise specified or indicated. Each plant or group of planting shall have a "key"

number indicated on the nursery certifications of the plant schedule. Furnish plants grown under climatic conditions similar to those in the locality of the project and within a 500-mile radius of the Project Site. Spray plants budding into leaf or having soft growth with an antidesiccant before digging. Plants of the same specified size shall be of uniform size and character of growth. All plants shall comply with all Federal and State Laws requiring inspection for plant diseases and infestation.

2.1.2 Shape and Condition

Well-branched, well-formed, sound, vigorous, healthy planting stock free from disease, sunscald, windburn, abrasion, and harmful insects or insect eggs and having a healthy, normal, and undamaged root system.

2.1.2.1 Deciduous Trees and Shrubs

Symmetrically developed and of uniform habit of growth, with straight boles or stems, and free from objectionable disfigurements.

2.1.2.2 Evergreen Trees and Shrubs

Well developed symmetrical tops with typical spread of branches for each particular species or variety.

2.1.2.3 Ground Covers and Vines

Number and length of runners and clump sizes indicated, and of the proper age for the grade of plants indicated, furnished in removable containers, integral containers, or formed homogeneous soil section.

2.1.3 Plant Size

Minimum sizes measured after pruning and with branches in normal position, shall conform to measurements indicated, based on the average width or height of the plant for the species as specified in ANSI Z60.1. Plants larger in size than specified may be provided with approval of the Owner's Representative. When larger plants are provided, increase the ball of earth or spread of roots in accordance with ANSI Z60.1.

2.1.4 Root Ball Size

All box-grown, field potted, field boxed, collected, plantation grown, bare root, balled and burlapped, container grown, processed-balled, and in-ground fabric bag-grown root balls shall conform to ANSI Z60.1. All wrappings and ties shall be biodegradable. Root growth in container grown plants shall be sufficient to hold earth intact when removed from containers. Root bound plants will not be accepted.

2.1.4.1 Mycorrhizal fungi inoculum

Before shipment, root systems shall contain mycorrhizal fungi inoculum.

2.1.5 Growth of Trunk and Crown

2.1.5.1 Deciduous Trees

A height to caliper relationship shall be provided in accordance with ANSI Z60.1. Height of branching shall bear a relationship to the size and species of tree specified and with the crown in good balance with the

trunk. The trees shall not be "poled" or the leader removed.

a. Single stem: The trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.

b. Multi-stem: All countable stems, in aggregate, shall average the size specified. To be considered a stem, there shall be no division of the trunk which branches more than 6 inches from ground level.

2.1.5.2 Deciduous Shrubs

Deciduous shrubs shall have the height and number of primary stems recommended by ANSI Z60.1. Acceptable plant material shall be well shaped, with sufficient well-spaced side branches, and recognized by the trade as typical for the species grown in the region of the project.

2.1.5.3 Coniferous Evergreen Plant Material

Coniferous Evergreen plant material shall have the height-to-spread ratio recommended by ANSI Z60.1. The coniferous evergreen trees shall not be "poled" or the leader removed. Acceptable plant material shall be exceptionally heavy, well shaped and trimmed to form a symmetrical and tightly knit plant. The form of growth desired shall be as indicated.

2.1.5.4 Broadleaf Evergreen Plant Material

Broadleaf evergreen plant material shall have the height-to-spread ratio recommended by ANSI Z60.1. Acceptable plant material shall be well shaped and recognized by the trade as typical for the variety grown in the region of the project.

2.1.5.5 Ground Cover and Vine Plant Material

Ground cover and vine plant material shall have the minimum number of runners and length of runner recommended by ANSI Z60.1. Plant material shall have heavy, well developed and balanced crown with vigorous, well developed root system and shall be furnished in containers.

2.2 TOPSOIL

2.2.1 Existing Soil

Modify to conform to requirements specified in paragraph entitled "Composition."

2.2.2 Off-Site Topsoil

Conform to requirements specified in paragraph entitled "Composition." Additional topsoil shall be furnished by the Contractor.

2.2.3 Composition

From 5 to 10 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42. Maximum particle size, 3/4 inch, with maximum 3 percent retained on 1/4 inch screen. The pH shall be tested in accordance with ASTM D 4972. Topsoil shall be free of sticks, stones, roots, and other debris and objectionable materials. Other components shall conform

to the following limits:

Silt	25-50 Percent
Clay	10-30 Percent
Sand	20-35 Percent
pH	5.5 to 7.0
Soluble Salts	600 ppm maximum

2.3 SOIL CONDITIONERS

Provide singly or in combination as required to meet specified requirements for topsoil. Soil conditioners shall be nontoxic to plants.

2.3.1 Lime

Commercial grade hydrated or burnt limestone containing a calcium carbonate equivalent (C.C.E.) as specified in ASTM C 602 of not less than 80 percent.

2.3.2 Aluminum Sulfate

Commercial grade.

2.3.3 Sulfur

100 percent elemental

2.3.4 Iron

100 percent elemental

2.3.5 Peat

Natural product of peat moss derived from a freshwater site and conforming to ASTM D 4427 as modified herein. Shred and granulate peat to pass a 1/2 inch mesh screen and condition in storage pile for minimum 6 months after excavation.

2.3.6 Sand

Clean and free of materials harmful to plants.

2.3.7 Perlite

Horticultural grade.

2.3.8 Composted Derivatives

Ground bark, nitrolized sawdust, humus or other green wood waste material free of stones, sticks, and soil stabilized with nitrogen and having the following properties:

2.3.8.1 Particle Size

Minimum percent by weight passing:

No. 4 mesh screen	95
No. 8 mesh screen	80

2.3.8.2 Nitrogen Content

Minimum percent based on dry weight:

Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.3.9 Gypsum

Coarsely ground gypsum comprised of calcium sulfate dihydrate 91 percent, calcium 22 percent, sulfur 17 percent; minimum 96 percent passing through 20 mesh screen, 100 percent passing thru 16 mesh screen.

2.4 PLANTING SOIL MIXTURES

100 percent topsoil as specified herein.

2.5 FERTILIZER

2.5.1 Granular Fertilizer

Synthetic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

16 percent available nitrogen
7 percent available phosphorus
12 percent available potassium
2 percent iron

2.5.2 Fertilizer Tablets

Synthetic,plant tablets composed of tightly compressed fertilizer chips forming a tablet that is insoluble in water, is designed to provide a continuous release of nutrients for at least 24 months and contains the following minimum percentages, by weight, of plant food nutrients:

20 percent available nitrogen
20 percent available phosphorus
5 percent available potassium

2.6 WEED CONTROL FABRIC

2.6.1 Roll Type Polypropylene or Polyester Mats

Fabric shall be woven, needle punched or non-woven and treated for protection against deterioration due to ultraviolet radiation. Fabric shall be minimum 99 percent opaque to prevent photosynthesis and seed germination from occurring, yet allowing air, water and nutrients to pass thru to the roots. Minimum weight shall be 5 ounces per square yard with a minimum thickness of 20 mils with a 20 year (minimum) guarantee.

2.7 MULCH

Free from noxious weeds, mold, or other deleterious materials.

2.7.1 Inert Mulch Materials

Crushed bricks ranging in size from 0.25 to 2 inches.

2.7.2 Organic Mulch Materials

Shredded hardwood.

2.7.3 Recycled Organic Mulch

Recycled mulch may include compost, tree trimmings, or pine needles with a gradation that passes through a 2-1/2 by 2-1/2 inchscreen. It shall be cleaned of all sticks a minimum 1 inch in diameter and plastic materials a minimum 3 inches length. The material shall be treated to retard the growth of mold and fungi.

2.8 STAKING AND GUYING MATERIAL

2.8.1 Staking Material

2.8.1.1 Tree Support Stakes

Rough sawn hard wood free of knots, rot, cross grain, bark, long slivers, or other defects that impair strength. Stakes shall be minimum 2 inches square or 2 1/2 inch diameter by 8 feet long, pointed at one end.

2.8.1.2 Ground Stakes

2 inches square are by 3 feet long, pointed at one end.

2.8.2 Guying Material

2.8.2.1 Guying Wire

12 gauge annealed galvanized steel, ASTM A 580/A 580M.

2.8.2.2 Guying Cable

Minimum five-strand, 3/16 inch diameter galvanized steel cable.

2.8.3 Hose Chafing Guards

New or used 2 ply 3/4 inch diameter reinforced rubber or plastic hose, black or dark green, all of same color.

2.8.4 Flags

White surveyor's plastic tape, 6 inches long, fastened to guying wires or cables.

2.8.5 Turnbuckles

Galvanized or cadmium-plated steel with minimum 3 inch long openings fitted with screw eyes. Eye bolts shall be galvanized or cadmium-plated steel with one inch diameter eyes and screw length 1 1/2 inches, minimum.

2.8.6 Deadmen

4 by 8 inch rectangular or 8 inch diameter by36 inch long, pine fir, or other wood material.

2.8.7 Metal Anchors

2.8.7.1 Driven Anchors

Malleable iron, arrow shaped, galvanized, sized as follows:

Tree Caliper	Anchor Size
2 inches and under	3 inches
3 to 6 inches	4 inches
6 to 8 inches	6 inches
8 to 10 inches	8 inches
10 to 12 inches	10 inches

2.8.7.2 Screw Anchors

Steel, screw type with welded-on 3 inch round helical steel plate, minimum 3/8 inch diameter, 15 inches long.

2.9 EDGING MATERIAL

2.9.1 Metal Edging

Galvanized steel with slots for stakes and thick by 1/8 inch thick by 5 inch deep in 20 foot lengths. Treat steel edging with rust preventative and factory finish in color brown. Anchoring stakes shall be tapered galvanized steel with same finish as metal edging, 16 to 18 inches long.

2.10 ANTIDESICCANTS

Sprayable, water insoluble vinyl-vinledine complex which produce a moisture retarding barrier not removable by rain or snow. Film shall form at temperatures commonly encountered out of doors during planting season and have a moisture vapor transmission rate (MVT) of the resultant film of maximum 10 grams per 24 hours at 70 percent humidity.

2.11 WATER

Source of water to be approved by Owner's Representative and suitable quality for irrigation and shall not contain elements toxic to plant life.

2.12 MYCORRHIZAL FUNGI INOCULUM

Mycorrhizal fungi inoculum shall be composed of multiple-fungus inoculum as recommended by the manufacturer for the plant material specified.

2.13 SOURCE QUALITY CONTROL

The Owner's Representative and Landscape Architect of Record will inspect plant materials at the project site and approve them. Tag plant materials for size and quality.

PART 3 EXECUTION

3.1 EXTENT OF WORK

Provide soil preparation, fertilizing, tree, shrub, vine, groundcover, and planting, edging, staking and guying, weed control fabric, erosion control material and installation and a mulch topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.2 PREPARATION

3.2.1 Layout

Stake out approved plant material locations and planter bed outlines on the project site before digging plant pits or beds. The Owner's Representative reserves the right to adjust plant material locations to meet field conditions. Do not plant closer than 36 inches to a building wall, pavement edge, fence or wall edge and other similar structures.

3.2.2 Soil Preparation

3.2.2.1 pH Adjuster Application Rates

Apply pH adjuster at rates as determined by laboratory soil analysis of the soils at the job site.

3.2.2.2 Soil Conditioner Application Rates

Apply soil conditioners at rates as determined by laboratory soil analysis of the soils at the job site.

3.2.2.3 Fertilizer Application Rates

Apply fertilizer at rates as determined by laboratory soil analysis of the soils at the job site.

3.3 PLANT BED PREPARATION

Verify location of underground utilities prior to excavation. Protect existing adjacent turf before excavations are made. Where planting beds occur in existing turf areas, remove turf to a depth that will ensure removal of entire root system. Measure depth of plant pits from finished grade. Depth of plant pit excavation shall be as indicated and provide proper relation between top of root ball and finished grade. Install plant material as specified in paragraph entitled "Plant Installation." Do not install trees within 10 feet of any utility lines or building walls.

3.4 PLANT INSTALLATION

3.4.1 Individual Plant Pit Excavation

Excavate pits at least twice as large as the diameter of the ball or container to depth shown.

3.4.2 Plant Beds with Multiple Plants

Excavate plant beds continuously throughout entire bed as outlined to depth shown.

3.4.3 Handling and Setting

Move plant materials only by supporting the root ball or container. Set plants on native soil and hold plumb in the center of the pit until soil has been tamped firmly around root ball. Set plant materials, in relation to surrounding finish grade, one to 2 inches above depth at which they were grown in the nursery, collecting field or container. Replace plant material whose root balls are cracked or damaged either before or during the planting process.

Plant material shall be set in plant beds according to the drawings. Backfill soil mixture shall be placed on previously scarified subsoil to completely surround the root balls, and shall be brought to a smooth and even surface, blending to existing areas.

3.4.3.1 Balled and Burlapped Stock

Backfill with prepared soil mixture to approximately half the depth of ball and then tamp and water. Carefully remove or fold back excess burlap and tying materials from the top a minimum 1/3 depth from the top of the rootball. Tamp and complete backfill, place mulch topdressing, and water. Remove wires and non-biodegradable materials from plant pit prior to backfill operations.

3.4.3.2 Container Grown Stock

Remove from container and prevent damage to plant or root system.

3.4.3.3 Ground Covers and Vines

Plant after placing mulch topdressing. Do not remove plant materials from flats or containers until immediately before planting. Space at intervals indicated. Plant at a depth to sufficiently cover all roots. Start watering areas planted as required by temperature and wind conditions. Apply water at a rate sufficient to ensure thorough wetting of soil to a depth of 4 inches without run off. Smooth planting areas after planting to provide even, smooth finish. Mulch as indicated.

3.4.4 Earth Mounded Watering Basin for Individual Plant Pits

Form with topsoil around each plant by replacing a mound of topsoil around the edge of each plant pit. Watering basins shall be 6 inches deep for trees and 4 inches deep for shrubs. Eliminate basins around plants in plant beds containing multiple plants.

3.4.5 Weed Control Fabric Installation

Remove grass and weed vegetation, including roots, from within the area enclosed by edging. Completely cover areas enclosed by edging with specified weed control fabric prior to placing mulch layer. Overlap cut edges 6 inches.

3.4.6 Erosion Control Material

Install in accordance with manufacturer's instructions.

3.4.7 Placement of Mulch Topdressing

Place specified mulch topdressing on top of weed control fabric covering total area enclosed by edging. Place mulch topdressing to a depth of 3 inches.

3.4.8 Mulch Topdressing

Provide mulch topdressing over entire planter bed surfaces and individual plant surfaces including earth mound watering basin around plants to a depth of 3 inches after completion of plant installation and before watering. Keep mulch out of the crowns of shrubs. Place mulch a minimum 2

to 3 inches away from trunk of shrub or tree. Place on top of any weed control fabric.

3.4.9 Installation of Edging

Uniformly spade edge beds of plants to provide a clear cut division line between planted area and adjacent lawn. Construct bed shapes as indicated. Install metal edging material as indicated and as per manufacturer's instructions around brick mulch only. Install edging with minimum one inch left above ground level.

3.4.10 Fertilization

3.4.10.1 Fertilizer Tablets

Place fertilizer planting tablets evenly spaced around the plant pits to the manufacturer's recommended depth.

3.4.10.2 Granular Fertilizer

Apply granular fertilizer as a top coat prior to placing mulch layer and water thoroughly.

3.4.11 Watering

Start watering areas planted as required by temperature and wind conditions. Apply water at a rate sufficient to ensure thorough wetting of soil to a depth of 12 inches without run off.

3.4.12 Staking and Guying

3.4.12.1 Staking

Stake plants with the number of stakes indicated complete with double strand of 12 gage guy wire as detailed. Attach guy wire half the tree height but not more than 5 feet high. Drive stakes to a depth of 2 1/2 to 3 feet into the ground outside the plant pit. Do not injure the root ball. Use hose chafer guards where guy wire comes in contact with tree trunk.

3.4.12.2 Guying

Guy plants as indicated. Attach two strands of guying wire around the tree trunk at an angle of 45 degrees at approximately 1/2 of the trunk height. Protect tree trunks with chafing guards where guying wire contacts the tree trunk. Anchor guys to deadmen wood blocks wood ground stakes, malleable iron anchors or steel screw anchors. Fasten flags to each guying wire approximately 2/3 of the distance up from ground level. Provide turnbuckles as needed.

3.4.12.3 Chafing Guards

Use hose chafing guards, as specified where guy wire will contact the plant.

3.4.12.4 Wood Ground Stakes

Drive wood ground stakes into firm ground outside of plant pit with top of stake flush with ground. Place equal distance from tree trunk and around the plant pit.

3.4.12.5 Iron Anchors

Drive malleable iron anchors into firm ground outside of plant pit a minimum 30 inches below finish grade. Place equal distance from tree trunk and around the plant pit.

3.4.12.6 Steel Screw Anchors

Insert steel screw anchors as recommended in manufacturer's data. Place equal distance from tree trunk and around the plant pit.

3.4.12.7 Flags

Securely fasten flags on each guy wire approximately two-thirds of the distance up from ground level.

3.4.13 Pruning

Prune in accordance with safety requirement of ANSI Z133.1.

3.4.13.1 Trees and Shrubs

Remove dead and broken branches. Prune to correct structural defects only. Retain typical growth shape of individual plants with as much height and spread as practical. Do not cut central leader on trees. Make cuts with sharp instruments. Do not flush cut with trunk or adjacent branches. Collars shall remain in place. Pruning shall be accomplished by trained and experienced personnel and shall be accordance with ANSI A300.

3.4.13.2 Wound Dressing

Do not apply tree wound dressing to cuts.

3.5 RESTORATION AND CLEAN UP

3.5.1 Restoration

Turf areas, pavements and facilities that have been damaged from the planting operation shall be restored to original condition at the Contractor's expense.

3.5.2 Clean Up

Excess and waste material shall be removed from the installed area and shall be disposed offsite. Adjacent paved areas shall be cleared.

-- End of Section --

SECTION 02935

LANDSCAPE ESTABLISHMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z133.1	(2001) Arboricultural Operations -- Safety Requirements for Pruning, Repairing, Maintaining, and Removing Trees, and Cutting Brush
ANSI Z88.2	(1992) Respiratory Protection

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910-SUBPART Z	Toxic and Hazardous Substances

1.2 DEFINITIONS

1.2.1 Pesticide

Any substance or mixture of substances, including biological control agents, that may pervent, destroy, repel, or mitigate pests and are specifically labeled for use by the U.S. Environmental Protection Agency (EPA). Also, any substance used as a plant regulator, defoliant, disinfectant, or biocide. Examples of pesticides include fumigants, herbicides, insecticides, fungicides, nematicides, molluscicides and rodenticides.

1.2.2 Stand of Turf

95 percent ground cover of the established species.

1.2.3 Planter Beds

A planter bed is defined as an area containing one or a combination of the following plant types: shrubs, vines, wildflowers, annuals, perennials, ground cover, and a mulch topdressing excluding turf. Trees may also be found in planter beds.

1.3 RELATED REQUIREMENTS

Section 02921 SEEDING applies to this section for installation of seed requirements, with additions and modifications herein.

Section 02930 EXTERIOR PLANTS applies to this section for installation of trees, shrubs, ground cover, vines, and wildflower, with additions and modifications herein.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Pesticides

Provide list of pesticides proposed for use on the appropriate pesticides purchase and use approval request form.

SD-03 Product Data

Fertilizer

Pesticides

Provide pesticide label and Material Safety Data Sheet for each proposed pesticide.

Include physical characteristics, application instructions and recommendations.

SD-07 Certificates

Pesticide applicator's certification

Maintenance inspection report

SD-08 Manufacturer's Instructions

Pesticides

SD-11 Closeout Submittals

Pesticides

Tree, staking and guying removal

Provide list of pesticides used on the project; submit on the appropriate Pest Management Record Form.

1.5 DELIVERY, STORAGE AND HANDLING

1.5.1 Delivery

1.5.1.1 Fertilizer, Gypsum, Iron Delivery

Deliver to the site in original containers bearing manufacturer's chemical analysis, name, trade name, or trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer, gypsum may be furnished in bulk with a certificate indicating the above information.

1.5.1.2 Pesticide Delivery

Deliver to the site in original containers with legible manufacturer's label attached.

1.5.2 Storage

1.5.2.1 Fertilizer, Lime, Iron, Mulch Storage

Material shall be stored in designated areas. Lime and fertilizer shall be stored in cool, dry locations away from contaminants.

1.5.2.2 Pesticides Antidessicants Storage

Do not store with fertilizers or other landscape maintenance materials. Store herbicides "downwind," relative to the airflow in the storage building, from other pesticides, and provide physical separation between herbicides and other pesticides.

1.5.3 Handling

Do not drop or dump materials from vehicles.

PART 2 PRODUCTS

2.1 POST-PLANT FERTILIZER

2.1.1 Granular Fertilizer

Organic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

16 percent available nitrogen
7 percent available phosphorus
12 percent available potassium
2 percent iron

2.2 WATER

Source of water shall be approved by the Owner's Representative, and be of suitable quality for irrigation.

2.3 MULCHES TOPDRESSING

Free from noxious weeds, mold, or other deleterious materials.

2.3.1 Inert Mulch Materials

Crushed bricks ranging in size from 0.25 to 2 inches.

2.3.2 Organic Mulch Materials

Shredded hardwood

2.3.3 Recycled Organic Mulch

Recycled mulch may include compost, tree trimmings, or pine needles with a gradation that passes through a 2-1/2 by 2-1/2 inch screen. It shall be cleaned of all sticks a minimum 1 inch in diameter and plastic materials a minimum 3 inch length. The material shall be treated to retard the growth of mold and fungi.

2.4 PESTICIDES

Fumigant, Herbicide, Insecticide, Fungicide and Rodenticide: EPA registered and approved. Furnish for preemergence and postemergence application for crabgrass control and broadleaf weed control. Comply with Federal Insecticide, Fungicide, and Rodenticide Act (Title 7 U.S.C. Section 136) for requirements on contractor's licensing, certification, and record keeping. Contractor to keep records of all pesticide applications and forward data monthly to Owner's Representative. Submit record keeping format to Owner's Representative, for approval.

PART 3 EXECUTION

3.1 EXTENT OF WORK

Provide landscape construction maintenance to include irrigation equipment cleaning and adjustments, mowing, edging, overseeding, aeration, fertilizing, watering, weeding, stake and guy adjusting, and pesticide application for all newly installed renovated landscape areas, and existing plant material, unless indicated otherwise, and at all areas inside or outside the limits of the construction that are disturbed by the Contractor's operations.

3.1.1 Policing

The Contractor shall police all landscaped areas. Policing includes removal of leaves, branches and limbs regardless of length or diameter, dead vegetation, paper, trash, cigarette butts, garbage, rocks or other debris. Collected debris shall be promptly removed and disposed of at an approved disposal site.

3.1.2 Drainage System Maintenance

The Contractor shall remove all obstructions from surface and subsurface drain lines to allow water to flow unrestricted in swales, gutters, catch basins, storm drain curb inlets, and yard drains. Remove grates and clear debris in catch basins. Open drainage channels are to be maintained free of all debris and vegetation at all times. Edges of these channels shall be clear of any encroachment by vegetation.

3.2 Water Restrictions

The Contractor shall abide by state, local or other water conservation regulations in force during the establishment period.

3.3 TURF ESTABLISHMENT PERIOD

Turf establishment period will commence on the date that inspection by the Owner's Representative, and/or Architect/Engineer shows that the new or renovated turf furnished under this contract has been satisfactorily installed to a 95 percent stand of coverage. The establishment period shall continue for a period of 365 days.

3.3.1 Frequency of Maintenance

Begin maintenance immediately after turf has been installed or fully renovated. Inspect turf areas once a week during the installation and

establishment period and perform needed maintenance promptly.

3.3.2 Promotion of Turf Growth

Turf shall be maintained in a manner that promotes proper health, growth, rich natural green color, and neat uniform manicured appearance, free of bare areas, ruts, holes, weeds, pests, dead vegetation, debris, and unwanted vegetation that present an unsightly appearance. Mow, remove excess clippings, eradicate weeds, water, fertilize, overseed, aerate, topdress and perform other operations necessary to promote turf growth.

3.3.3 Mowing

Turf shall be mowed at a uniform finished height. Mow turfed areas to an average height of 3 inches when average height of grass becomes 4 inches for spring/summer maintenance and to an average height of 3 inches when the average height of grass reaches 4 inches for fall maintenance. The height of turf is measured from the soil. Mowing of turf shall be performed in a manner that prevents scalping, rutting, bruising, uneven and rough cutting. Prior to mowing, all rubbish, debris, trash, leaves, rocks, paper, and limbs or branches on a turf area shall be picked up and disposed. Adjacent paved areas shall be swept/vacuumed clean.

3.3.4 Turf Edging and Trimming

Perimeter of planter bed edges, sidewalks, driveways, curbs, and other paved surfaces shall be edged. Uniformly edge these areas to prevent encroachment of vegetation onto paved surfaces and to provide a clear cut division line between planter beds, turf, and ground cover. Edging is to be accomplished in a manner that prevents scalping, rutting, bruising, uneven and rough cutting. Edging shall be performed on the same day that turf is mowed. Use of string line trimmers is permitted in "soft" areas such as an edge between turfgrass and a planter bed. Care shall be exercised to avoid damage to any plant materials, structures, and other landscape features.

Trimming around trees, fences, poles, walls and other similar objects is to be accomplished to match the height and appearance of surrounding mowed turf growth. Trimming shall be performed on the same day the turf's mowed. Care shall be exercised to avoid "Girdling" trees located in turf areas. The use of protective tree collars on trees in turf areas may be utilized as a temporary means to avoid injury to tree trunks. At the end of the plant establishment period Contractor will be responsible for removing all protective tree collars.

3.3.5 Turf Post-Fertilizer Application

Apply fertilizer in a manner that promotes health, growth, vigor, color and appearance of cultivated turf areas. The method of application, fertilizer type and frequencies shall be determined by the laboratory soil analysis results the requirements of the particular turf species. Fertilizer shall be applied by approved methods in accordance with the manufacturer's recommendations.

3.3.6 Turf Watering

The Contractor shall perform irrigation in a manner that promotes the health, growth, color and appearance of cultivated vegetation and that complies with all Federal, State, and local water agencies and authorities

directives. The Contractor shall be responsible to prevent over watering, water run-off, erosion, and ponding due to excessive quantities or rate of application. The Contractor shall abide by state, local or other water conservation regulations or restrictions in force during the establishment period.

3.3.7 Turf Aeration

Upon completion of weed eradication operations and Owner's Representative, approval to proceed, aerate turf areas by approved device. Core, by pulling soil plugs, to a minimum depth of 2 inches. Leave all soil plugs, that are produced, in the turf area.

Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean all soil plugs off of other paving when work is complete. This work shall commence 30 days prior final acceptance of the maintenance establishment period.

3.3.8 Turf Clearance Area

Trees located in turf areas shall be maintained with a growth free clearance of 18 inchesfrom the tree trunk base. The use of mechanical weed whips to accomplish the turf growth free bed area is prohibited.

3.3.9 Replanting

Replant in accordance with Section 02921 SEEDING within specified planting dates areas which do not have a satisfactory stand of turf.

3.3.10 Final Inspection and Acceptance

Final inspection will be make upon written request from the Contractor at least 10 days prior to the last day of the turf establishment period. Final acceptance will be based upon a satisfactory stand of turf.

3.4 EXTERIOR PLANT ESTABLISHMENT PERIOD

The exterior plant establishment period will commence on the date that inspection by the Owner's Representative, Architect/Engineer shows that the new plants furnished under this contract have been satisfactorily installed and shall continue for a period of 365 days.

3.4.1 Frequency of Maintenance

Begin maintenance immediately after plants have been installed. Inspect exterior plants at least once a week during the installation and establishment period and perform needed maintenance promptly.

3.4.2 Promotion of Plant Growth and Vigor

Water, prune, fertilize, mulch, adjust stakes, guys and turnbuckles, eradicate weeds and perform other operations necessary to promote plant growth, and vigor.

3.4.3 Planter Bed Maintenance

Planter beds shall be weeded, fertilized, irrigated, kept pest free, turf free, pruned, and mulch levels maintained. Planter beds will not be allowed to encroach into turf areas. A definite break shall be maintained

between turf areas and planter beds.

3.4.3.1 Shrub Selective Maintenance

In addition to the above requirements, shrubs shall be selectively pruned, and shaped for health and safety when the following conditions exist: Remove growth in front of windows, over entrance ways or walks, and any growth which will obstruct vision at street intersections; Remove dead, damaged or diseased branches or limbs; where shrub growth obstructs pedestrian walkways; where shrub growth is found growing against or over structures. All pruning debris shall be disposed of in a proper manner.

3.4.3.2 Tree Maintenance

Tree maintenance shall include adjustment of stakes, ties, guy supports and turnbuckles, watering, fertilizing, pest control, mulching, pruning for health and safety. Stakes, ties, guy supports and turnbuckles shall be inspected and adjusted to avoid girdling and promote natural development. All trees within the project boundaries, regardless of caliper, shall be selectively pruned for safety and health reasons. These include but are not limited to removal of dead and broken branches and correction of structural defects. Prune trees according to their natural growth characteristics leaving trees well shaped and balanced. Pruning of all trees shall be accomplished by or in the presence of a certified member of the International Society of Arboriculture and in accordance with ANSI Z133.1. All pruning debris generated shall be disposed of in a proper manner.

3.4.4 Slope Erosion Control Maintenance

The Contractor shall provide slope erosion control maintenance to prevent undermining of all slopes in newly landscaped and natural growth areas. Maintenance tasks include immediate repairs to weak spots in sloped areas, and maintaining clean, clear culverts, and graded berms, and terraces to intercept and direct water flow to prevent development of large gullies and slope erosion and eroded areas shall be filled with amended topsoil and replanted with the same plant species. Erosion control netting and blankets damaged due to slope erosion shall be reinstalled.

3.4.5 Removal of Dying or Dead Plants

Remove dead and dying plants and provide new plants immediately upon commencement of the specified planting season, and replace stakes, guys, mulch and eroded earth mound water basins. No additional plant establishment period will be required for replacement plants beyond the original warranty period. A tree shall be considered dying or dead when the main leader has died back, or a minimum of 20 percent of the crown has died. A shrub or ground cover shall be considered dying or dead when a minimum of 20 percent of the plant has died. This condition shall be determined by scraping on a branch an area 1/16 inch square, maximum, to determine the cause for dying plant material and shall provide recommendations for replacement. The Contractor shall determine the cause for dying plant material and provide recommendations for replacement.

3.4.6 Tracking of Unhealthy Plants

Note plants not in healthy growing condition, as determined by the Owner's Representative or Architect/Engineer, and as soon as seasonal conditions permit, remove and replace with plants of the same species and sizes as

originally specified. Install replacement plantings in accordance with Section 02930 EXTERIOR PLANTS.

3.4.7 Final Inspection

Final inspection will be made upon written request from the Contractor at least 10 days prior to the last day of the establishment period. Final inspection will be based on the following:

3.4.7.1 Total Plants on Site

Plants have been accepted and required number of replacements have been installed.

3.4.7.2 Mulching and Weeding

Planter beds and earth mound water basins are properly mulched and free of weeds.

3.4.7.3 Tree Supports

Stakes guys and turnbuckles are in good condition.

3.4.7.4 Remedial Work

Remedial measures directed by the Owner's Representative to ensure plant material survival and promote healthy growth have been completed.

3.5 PESTICIDE APPLICATION

Use pesticides when required to eliminate plant diseases and harmful insects or insect eggs from plant materials. The Contractor shall furnish all labor, supervision, tools, materials, equipment, and transportation necessary to provide Pest Control Services as required.

3.5.1 State Licensing

The Contractor shall be licensed by the State to provide pest control in the categories in which work will be performed.

3.5.2 Certified and Licensed Applicators

All pesticide applications shall be performed by individuals who are state licensed or certified in the appropriate categories for the type of pest control to be performed. The applicator must be capable of reading, understanding and executing all of the requirements and recommendations outlined on the manufacturer's label. All pesticides must be used in accordance with the Federal, state, local, and installation laws, publications, and any requirements identified in attachments. All pesticides shall be procured, processed, handled, and applied in strict accordance with the manufacturer's label. All pesticides shall be registered with the U.S. Environmental Protection Agency and State in which they will be used.

3.5.3 Pesticide Use Inspections

Pesticide applications will be inspected by a designated Pest Management Coordinator or trained Pest Management Quality Assurance Evaluator. The Contractor shall notify the,Owner's Representative immediately, by

telephone, of any inspection visits by any Federal or State enforcement officials.

3.5.4 Pesticide Approval

The Contractor shall submit to the Owner's Representative a list of pesticides "proposed for use" prior to initiation of work on the correct submission form. The Owner's Representative must approve the pesticides proposed before they can be used. Copies of the pesticide complete label and Material Safety Data Sheet (MSDS) for each pesticide proposed for use must be included. Copies of the State business license as an applicator of pesticides and the pesticide applicator's certification information must also be attached. If the Contractor wishes to use a pesticide not currently on the "list" (previously submitted), the new pesticide must be submitted to the Owner's Representative for approval on the correct submission form. Once pesticides are approved by the Owner's Representative they can be used throughout the course of the contract provided that registration is not revoked by the EPA or the State. The government reserves the right to remove any pesticide from use at anytime.

3.5.5 Application and Reporting Procedure

Notify the Owner's Representative 24 hours before application. Apply pesticides in accordance with EPA label restrictions and recommendations and federal and state laws. Make daily reports to the Owner's Representative stating areas treated with each chemical, the quantity applied, and spray mixture or formulation used. The Contractor shall maintain a label book of pesticides used, including all appropriate Material Safety Data Sheets (MSDS), and have it readily available at all times for inspection. Pesticides shall always be stored in original containers having EPA-registered labels attached or in service containers that conform to all federal, state, or local regulations regarding containers for pesticide storage.

3.5.6 Application Safety Precautions

Apply in well ventilated areas. Avoid inhalation, injection, or spilling on clothing or skin. Wear personal protective equipment (PPE) that meets or exceeds the requirements indicated by the manufacturer's pesticide label. Do not expose personnel to pesticides exceeding the exposure levels recommended in the most stringent of the following: OSHA, 29 CFR 1910-SUBPART Z, or the manufacturer's material safety data sheet. If excessive exposures are unavoidable, use respirators approved by the National Institute for Occupational Safety and Health for protection from pesticides. Conform to the selection and usage guidance in ANSI Z88.2. Ensure that application sites are clearly posted with re-entry intervals as required by the manufacturer's pesticide label.

3.5.7 Hydraulic Equipment

For liquid application of chemicals, hydraulic equipment shall have leakproof tanks and a positive agitation method. Calibrate and meter equipment so that application of chemicals in specified amounts can be determined. Provide equipment with gauges and valves capable of maintaining constant application pressures. Use application equipment appropriate for the nature and size of work, that is clean, calibrated, and in proper operational condition. Never leave equipment unattended during filling, and during application usage.

3.5.8 Personnel Injury and Property Damage Prevention

Apply in a manner to prevent injury to personnel, and damage to property, from either direct spray, or drifting of chemicals both on and off Government property.

3.5.9 Pesticide Disposal

The Contractor shall dispose of all excess pesticides, pesticide rinse water, empty pesticide containers, and any pesticide contaminated article in accordance with the label label and wire applicable State and Federal regulations. Pesticides, pesticide containers, pesticide residue, pesticide rinse water, or any pesticide contaminated articles shall not be disposed of on the project site. However, rinse water may be used as diluent for mixing the same pesticide.

3.5.10 Pesticide Spills, Clean Up and Decontamination

The Contractor shall be responsible for proper reporting, containment, clean up and decontamination of pesticide spills, as required by EPA and State Laws and Regulations. All spills shall be immediately reported to the Owner's Representative.

3.6 FIELD QUALITY CONTROL

3.6.1 Maintenance Inspection Report

Provide maintenance inspection report to assure that landscape maintenance is being performed in accordance with the specifications and in the best interest of plant growth and survivability. Site observations shall be documented at the start of the establishment period, then quarterly following the start, and at the end of establishment period. Results of site observation visits shall be submitted to the Owner's Representative within 7 calendar days of each site observation visit.

3.6.2 Plant Quantities

The Contractor shall provide Owner's Representative and Architect/Enginner with the number of plant quantities. In addition, provide total exterior area of hardscape and landscaping such as turf and total number of shrubs.

3.6.3 Tree Staking and Guying Removal

The Contractor shall provide a certified letter that all stakes and guys are removed from all project trees at the end of the establishment period.

-- End of Section --

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318/318R	(2002) Building Code Requirements for Structural Concrete and Commentary

ASTM INTERNATIONAL (ASTM)

ASTM A 184/A 184M	(2001) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	(2001) Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 53/A 53M	(2004a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 615/A 615M	(2000) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 675/A 675M	(2003) Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 82	(2001) Steel Wire, Plain, for Concrete Reinforcement

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 1MSP	(2001) Manual of Standard Practice

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Reinforcement

Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

SD-07 Certificates

Reinforcing Steel

Certified copies of mill reports attesting that the reinforcing steel furnished contains 95 percent or more recycled content, of which a minimum 60 percent shall be post-consumer and the remainder may be pre-consumer and meets the requirements specified herein, prior to the installation of reinforcing steel.

1.3 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 DOWELS

Dowels shall conform to ASTM A 675/A 675M, Grade 80. Steel pipe conforming to ASTM A 53/A 53M, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184/A 184M.

2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615/A 615M, grade 60, sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 82. Reinforcing steel shall contain 95 percent or more recycled content of which a minimum 60 percent shall be post-consumer and the remainder may be pre-consumer.

2.4 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 185. Provide welded wire fabric in flat mats, if available, in lieu of rolled mats.

2.5 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

2.6 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI 1MSP and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2 inch of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

PART 3 EXECUTION

3.1 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318/318R. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms.

3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318/318R at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318/318R. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318/318R and shall be made only as required or indicated. Splicing shall be by lapping. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6 inches.

3.2 WELDED-WIRE FABRIC PLACEMENT

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned by the use of supports.

3.3 DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

-- End of Section --

SECTION 03300

CAST-IN-PLACE STRUCTURAL CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 117/117R	(1990; R 2002) Standard Tolerances for Concrete Construction and Materials
ACI 211.1	(1991; R 2002) Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214.3R	(1988; R 1997) Simplified Version of the Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 305R	(1999) Hot Weather Concreting
ACI 318	(2002) Building Code Requirements for Structural Concrete

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(2005) Burlap Cloth Made from Jute or Kenaf and Cotton Mats

ASTM INTERNATIONAL (ASTM)

ASTM C 1017/C 1017M	(2003) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1059	(1999) Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C 1064/C 1064M	(2005) Temperature of Freshly Mixed Hydraulic-Cement Concrete
ASTM C 1107	(2002) Packaged Dry, Hydraulic-Cement Grout(Nonshrink)
ASTM C 1240	(2000e1) Silica Fume Used in Cementitious Mixtures
ASTM C 143/C 143M	(2005) Slump of Hydraulic Cement Concrete
ASTM C 150	(1999a) Portland Cement

ASTM C 171	(2003) Sheet Materials for Curing Concrete
ASTM C 172	(2004) Sampling Freshly Mixed Concrete
ASTM C 173/C 173M	(2001e1) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 231	(2004) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2001) Air-Entraining Admixtures for Concrete
ASTM C 33	(2003) Concrete Aggregates
ASTM C 39	(1999ae1) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 494/C 494M	(2005) Chemical Admixtures for Concrete
ASTM C 552	(2003) Cellular Glass Thermal Insulation
ASTM C 578	(2004) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(2001) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 595	(2001) Blended Hydraulic Cements
ASTM C 618	(1999) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 881/C 881M	(2002) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 937	(2002) Grout Fluidifier for Preplaced-Aggregate Concrete
ASTM C 94/C 94M	(2000) Ready-Mixed Concrete
ASTM C 989	(1999) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM D 1751	(2004) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004; Rev A) Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 75	(2003) Sampling Aggregates
ASTM E 1155	(1996; R 2001) Determining FF Floor Flatness and FL Floor Levelness Numbers

ASTM E 96/E 96M	(2000) Water Vapor Transmission of Materials

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(2004) NIST Handbook 44: Specifications, Tolerances, and other Technical Requirements for Weighing and Measuring Devices

NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA QC 3	(2002) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities
NRMCA TMMB 100	(2001) Truck Mixer, Agitator and Front Discharge Concrete Carrier Standards

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete
COE CRD-C 94	(1966) Specification for Surface Retarders

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mixture Proportions

The results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength or class of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.

Location(s) of product manufacture and of harvest/extraction/recovery of primary materials used in product. Designation of the percentages of post-consumer and pr-consumer recycled-content in cement and steel materials.

SD-06 Test Reports

Testing and Inspection for Quality Control

Certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

SD-07 Certificates

Qualifications

Written documentation for Contractor Quality Control personnel.

1.3 GENERAL REQUIREMENTS

1.3.1 Tolerances

Except as otherwise specified herein, tolerances for concrete batching, mixture properties, and construction as well as definition of terms and application practices shall be in accordance with ACI 117/117R. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing; when forms or shoring are used, the measurements shall be made prior to removal.

1.3.1.1 Floors by the F-Number System

The flatness and levelness of floors shall be carefully controlled and the tolerances shall be measured by the F-Number system of Paragraph 4.5.6 and 4.5.6.1 of ACI 117/117R. The Contractor shall furnish an approved floor profilograph or other equipment capable of measuring the floor flatness (FF) number and the floor levelness (FL) number in accordance with ASTM E 1155. The Contractor shall perform the tolerance measurements within 72 hours after floor slab construction while being observed by the Owners Representative. The tolerances of surfaces beyond the limits of ASTM E 1155 (the areas within 24 inches of embedments and construction joints) shall be acceptable to the Owner. Tolerances of the following areas shall meet the requirements for the listed surfaces as specified in paragraphs 4.5.6 and 4.5.6.1 of ACI 117/117R.

Trowel Finish - All interior slabs, except sloping areas
Flatness Standard - FF25

1.3.2 Strength Requirements and w/c Ratio

1.3.2.1 Strength Requirements

Specified compressive strength (f'c) shall be as follows and shall be verified thru testing in accordance with ACI 214.3R, and ACI 318:

COMPRESSIVE STRENGTH	STRUCTURE OR PORTION OF STRUCTURE
4000 psi at 28 days	Slab on grade and Cistern
3000 psi at 28 days	Footings

Concrete made with high-early strength cement shall have a 7-day strength equal to the specified 28-day strength for concrete made with Type I or II

portland cement. Compressive strength shall be determined in accordance with ASTM C 39.

1.3.2.2 Water-Cement Ratio

Maximum water-cement ratio (w/c) for normal weight concrete shall be as follows:

WATER-CEMENT RATIO, BY WEIGHT	STRUCTURE OR PORTION OF STRUCTURE
0.45	Slab on grade
0.50	Footings

These w/c's may cause higher strengths than that required above for compressive or flexural strength. The maximum w/c required will be the equivalent w/c as determined by conversion from the weight ratio of water to cement plus pozzolan, silica fume, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where silica fume or GGBF slag is used, the weight of the silica fume and GGBF slag shall be included in the equations of ACI 211.1 for the term P which is used to denote the weight of pozzolan.

1.3.3 Air Entrainment

All normal weight concrete shall be air entrained to contain between 4 and 7 percent total air, except that when the nominal maximum size coarse aggregate is 3/4 inch or smaller it shall be between 4.5 and 7.5 percent. Specified air content shall be attained at point of placement into the forms. Air content for normal weight concrete shall be determined in accordance with ASTM C 231.

1.3.4 Slump

Slump of the concrete, as delivered to the point of placement into the forms, shall be within the following limits. Slump shall be determined in accordance with ASTM C 143/C 143M.

	Slump	
Structural Element	Minimum	Maximum
Footings, slabs	1 in.	3 in.
Any structural concrete approved for placement by pumping:		
At pump	2 in.	6 in.
At discharge of line	1 in.	4 in.

When use of a plasticizing admixture conforming to ASTM C 1017/C 1017M or when a Type F or G high range water reducing admixture conforming to ASTM C 494/C 494M is permitted to increase the slump of concrete, concrete shall have a slump of 2 to 4 inches before the admixture is added and a maximum slump of 8 inches at the point of delivery after the admixture is added.

1.3.5 Concrete Temperature

The temperature of the concrete as delivered shall not exceed 90 degrees F. When the ambient temperature during placing is 40 degrees F or less, or is expected to be at any time within 6 hours after placing, the temperature of the concrete as delivered shall be between 55 and 75 degrees F.

1.3.6 Size of Coarse Aggregate

The largest feasible nominal maximum size aggregate (NMSA) shall be used in each placement. However, nominal maximum size of aggregate shall not exceed any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

1.3.7 Special Properties and Products

Concrete may contain admixtures other than air entraining agents, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if specified or approved. Any of these materials to be used on the project shall be used in the mix design studies.

1.4 MIXTURE PROPORTIONS

Concrete shall be composed of portland cement, other cementitious and pozzolanic materials as specified, aggregates, water and admixtures as specified.

1.5 STORAGE OF MATERIALS

Cement and other cementitious materials shall be stored in weathertight buildings, bins, or silos which will exclude moisture and contaminants and keep each material completely separated. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Aggregate shall not be stored directly on ground unless a sacrificial layer is left undisturbed. Reinforcing bars and accessories shall be stored above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless retested and proven to meet the specified requirements. Materials shall be capable of being accurately identified after bundles or containers are opened.

1.6 OWNER ASSURANCE INSPECTION AND TESTING

Day-to day inspection and testing shall be the responsibility of the Quality Control (QC) staff who is a independent agent of the owner. However, representatives of the Owner can and will inspect construction as considered appropriate and will monitor operations of the Owner's QC staff. Owner inspection or testing will not relieve the Contractor of any of his Own QC responsibilities.

1.6.1 Materials

The Owner's Representative will sample and test aggregates, cementitious

materials, other materials, and concrete to determine compliance with the specifications as considered appropriate. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Other materials will be sampled from storage at the jobsite or from other locations as considered appropriate. Samples may be placed in storage for later testing when appropriate.

1.6.2 Fresh Concrete

Fresh concrete will be sampled as delivered in accordance with ASTM C 172 and tested in accordance with these specifications, as considered necessary.

1.6.3 Hardened Concrete

Tests on hardened concrete will be performed by the Owner's Representative when such tests are considered necessary.

1.6.4 Inspection

Concrete operations may be tested and inspected by the Owner's Representative as the project progresses. Failure to detect defective work or material will not prevent rejection later when a defect is discovered nor will it obligate the Government for final acceptance. Testing and inspection of concrete shall be in conformance with ACI 318

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious Materials shall be portland cement, portland-pozzolan cement, portland blast-furnace slag cement, or portland cement in combination with pozzolan or ground granulated blast furnace slag or silica fume and shall conform to appropriate specifications listed below. Use of cementitious materials in concrete which will have surfaces exposed in the completed structure shall be restricted so there is no change in color, source, or type of cementitious material. Materials shall be manufactured and of primary raw materials harvested/extracted/recovered within a 500-mile radius of the Project Site.

2.2 Portland Cement

ASTM C 150, Type I

2.3 Blended Cements

ASTM C 595, Type IP,IS, P, I(PM), OR I(SM).

2.4 Pozzolan (Fly Ash)

Pozzolan shall conform to ASTM C 618, Class C or F. If pozzolan is used, it shall never be less than 15 percent nor more than 35 percent by weight of the total cementitious material.

2.5 Ground Granulated Blast-Furnace (GGBF) Slag

ASTM C 989, Grade 120.

2.1.6 Silica Fume

Silica fume shall conform to ASTM C 1240. Available alkalies shall conform to the optimal limit given in Table 2 of ASTM C 1240. Silica fume may be furnished as a dry, densified material or as a slurry. In accordance with paragraph Technical Service for Specialized Concrete, the Contractor shall provide at no cost to the Government the services of a manufacturer's technical representative experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume.

2.6 Fine Aggregate

Fine aggregate shall conform to the quality and gradation requirements of ASTM C 33. Materials shall be manufactured and of primary raw materials harvested/extracted/recovered within a 500-mile radius of the Project Site.

2.7 Coarse Aggregate

Coarse aggregate shall conform to ASTM C 33, Class 5S, size designation VDOT #57. Materials shall be manufactured and of primary raw materials harvested/extracted/recovered within a 500-mile radius of the Project Site.

2.8 CHEMICAL ADMIXTURES

Chemical admixtures, when required or permitted, shall conform to the appropriate specification listed. Admixtures shall be furnished in liquid form and of suitable concentration for easy, accurate control of dispensing.

2.8.1 Air-Entraining Admixture

ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions.

2.8.2 Accelerating Admixture

ASTM C 494/C 494M, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

2.8.3 Water-Reducing or Retarding Admixture

ASTM C 494/C 494M, Type A, B, or D, except that the 6-month and 1-year compressive and flexural strength tests are waived.

2.8.4 High-Range Water Reducer

ASTM C 494/C 494M, Type F or G, except that the 6-month and 1-year strength requirements are waived. The admixture shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.8.5 Surface Retarder

COE CRD-C 94.

2.8.6 Expanding Admixture

Aluminum powder type expanding admixture conforming to ASTM C 937.

2.8.7 Other Chemical Admixtures

Chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017/C 1017M, Type I or II. These admixtures shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.9 CURING MATERIALS

2.9.1 Impervious-Sheet

Impervious-sheet materials shall conform to ASTM C 171, type optional.

2.9.2 Burlap and Cotton Mat

Burlap and cotton mat used for curing shall conform to AASHTO M 182.

2.10 WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water may be used if it meets the requirements of COE CRD-C 400.

2.11 NONSHRINK GROUT

Nonshrink grout shall conform to ASTM C 1107, and shall be a commercial formulation suitable for the proposed application.

2.12 LATEX BONDING AGENT

Latex agents for bonding fresh to hardened concrete shall conform to ASTM C 1059.

2.13 EPOXY RESIN

Epoxy resins for use in repairs shall conform to ASTM C 881/C 881M, Type V, Grade 2. Class as appropriate to the existing ambient and surface temperatures.

2.14 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application.

2.15 FLOOR HARDENER

Floor hardener shall be a colorless aqueous solution containing zinc silicofluoride, magnesium silicofluoride, or sodium silicofluoride. These silicofluorides can be used individually or in combination. Proprietary hardeners may be used if approved in writing by the Owner's Representative.

2.16 PERIMETER INSULATION

Perimeter insulation shall be polystyrene conforming to ASTM C 578, Type II; polyurethane conforming to ASTM C 591, Type II; or cellular glass conforming to ASTM C 552, Type I or IV. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.17 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 10 mils or other equivalent material having a vapor permeance rating not exceeding 0.5 perms as determined in accordance with ASTM E 96/E 96M.

2.18 JOINT MATERIALS

2.18.1 Joint Fillers, Sealers, and Waterstops

Expansion joint fillers shall be preformed materials conforming to ASTM D 1751 or ASTM D 1752. Materials for waterstops shall be in accordance with Section 03150A EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS. Materials for and sealing of joints shall conform to the requirements of Section 07920 JOINT SEALANTS.

PART 3 EXECUTION

3.1 PREPARATION FOR PLACING

Before commencing concrete placement, the following shall be performed. Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Forms shall be in place, cleaned, coated, and adequately supported. Reinforcing steel shall be in place, cleaned, tied, and adequately supported. Transporting and conveying equipment shall be in-place, ready for use, clean, and free of hardened concrete and foreign material. Equipment for consolidating concrete shall be at the placing site and in proper working order. Equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the placing site, in proper working condition and in sufficient amount for the entire placement. When hot, windy conditions during concreting appear probable, equipment and material shall be at the placing site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

3.1.1 Foundations

3.1.1.1 Concrete on Earth Foundations

Earth (subgrade, base, or subbase courses) surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the foundation shall be well drained and shall be satisfactorily graded and uniformly compacted.

3.1.1.2 Excavated Surfaces in Lieu of Forms

Concrete for footings may be placed directly against the soil provided the earth has been carefully trimmed, is uniform and stable, and meets the compaction requirements of Section 02315. The concrete shall be placed without becoming contaminated by loose material, and the outline of the concrete shall be within the specified tolerances.

3.1.2 Vapor Barrier

Vapor barrier shall be provided beneath the interior on-grade concrete floor slabs. The greatest widths and lengths practicable shall be used to eliminate joints wherever possible. Joints shall be lapped a minimum of 12

inches. Torn, punctured, or damaged vapor barrier material shall be removed and new vapor barrier shall be provided prior to placing concrete. For minor repairs, patches may be made using laps of at least 12 inches. Lapped joints shall be sealed and edges patched with pressure-sensitive adhesive or tape not less than 2 inches wide and compatible with the membrane. Vapor barrier shall be placed directly on underlying subgrade, base course, or capillary water barrier. Concrete placement shall be controlled so as to prevent damage to the vapor barrier.

3.1.3 Perimeter Insulation

Perimeter insulation shall be installed at locations indicated. Adhesive shall be used where insulation is applied to the interior surface of foundation walls and may be used for exterior application.

3.1.4 Embedded Items

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Conduit and other embedded items shall be clean and free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding shall not be performed on embedded metals within 12 inches of the surface of the concrete. Tack welding shall not be performed on or to embedded items.

3.2 CONCRETE PRODUCTION

3.2.1 General Requirements

Concrete shall be furnished from a ready-mixed concrete plant. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94/C 94M, except as otherwise specified. Truck mixers, agitators, and nonagitating transporting units shall comply with NRMCA TMMB 100. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA QC 3. Approved batch tickets shall be furnished for each load of ready-mixed concrete.

3.2.2 Scales

The weighing equipment shall conform to the applicable requirements of CPMB Concrete Plant Standard, and of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. The tests shall be made at the specified frequency in the presence of a Government inspector. The weighing equipment shall be arranged so that the plant operator can conveniently observe all dials or indicators.

3.3 CONVEYING CONCRETE ON SITE

Concrete shall be conveyed from transporting unit to forms as rapidly as possible and within the time interval specified by methods which will prevent segregation or loss of ingredients using following equipment. Conveying equipment shall be cleaned before each placement.

3.3.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 2 square feet. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 2 cubic yards shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

3.3.2 Chutes

When concrete can be placed directly from a truck mixer, the chutes normally attached to this equipment by the manufacturer may be used.

3.3.3 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure type; pneumatic placing equipment shall not be used. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least 3 times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 4 inches. Aluminum pipe shall not be used.

3.4 PLACING CONCRETE

Mixed concrete shall be discharged within 1-1/2 hours or before the mixer drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates. When the concrete temperature exceeds 85 degrees F, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the transporting unit. Concrete shall be handled from mixer or transporting unit to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Sufficient placing capacity shall be provided so that concrete can be kept free of cold joints.

3.4.1 Depositing Concrete

Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 5 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 12 inches thick, except that all slabs shall be placed in a single lift. Concrete to receive other construction shall be screeded to the proper level. Concrete shall be deposited continuously in one layer or in layers so that fresh concrete is deposited on in-place concrete that is still plastic. Fresh concrete shall not be deposited on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. Concrete that has surface dried, partially hardened,

or contains foreign material shall not be used. When temporary spreaders are used in the forms, the spreaders shall be removed as their service becomes unnecessary.

3.4.2 Consolidation

Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 4 inches thick or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 10,000 vibrations per minute, an amplitude of at least 0.025 inch, and the head diameter shall be appropriate for the structural member and the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1.5 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a reasonable amount. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then vertically withdrawn slowly while operating. Form vibrators shall not be used unless specifically approved and unless forms are constructed to withstand their use. Vibrators shall not be used to move concrete within the forms. Slabs 4 inches and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique.

3.4.3 Cold Weather Requirements

Special protection measures, approved by the Owner's Representative, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 40 degrees F. The temperature of the concrete when placed shall be not less than 50 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Upon written approval, an accelerating admixture conforming to ASTM C 494/C 494M, Type C or E may be used, provided it contains no calcium chloride. Calcium chloride shall not be used.

3.4.4 Hot Weather Requirements

When the ambient temperature during concrete placing is expected to exceed 85 degrees F, the concrete shall be placed and finished with procedures previously submitted and as specified herein. The concrete temperature at time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C 1064/C 1064M. Cooling of the mixing water or aggregates or placing concrete in the cooler part of the day may be required to obtain an adequate placing temperature. A retarder may be used, as approved, to facilitate placing and finishing. Steel forms and reinforcements shall be cooled as approved prior to concrete placement when steel temperatures are greater than 120 degrees F. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature.

Maximum Allowable Concrete Placing Temperature

Relative Humidity, Percent, During Time of Concrete Placement	Maximum Allowable Concrete Temperature Degrees
Greater than 60	90 F
40-60	85 F
Less than 40	80 F

3.4.5 Prevention of Plastic Shrinkage Cracking

During hot weather with low humidity, and particularly with appreciable wind, as well as interior placements when space heaters produce low humidity, the Contractor shall be alert to the tendency for plastic shrinkage cracks to develop and shall institute measures to prevent this. Particular care shall be taken if plastic shrinkage cracking is potentially imminent and especially if it has developed during a previous placement. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 2.1.5 of ACI 305R. In addition the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, sprinkling, ponding or wet covering. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin as directed, after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

3.4.6 Placing Flowable Concrete

If a plasticizing admixture conforming to ASTM C 1017/C 1017M is used or if a Type F or G high range water reducing admixture is permitted to increase the slump, the concrete shall meet all requirements of paragraph GENERAL REQUIREMENTS in PART 1. Extreme care shall be used in conveying and placing the concrete to avoid segregation. Consolidation and finishing shall meet all requirements of paragraphs Placing Concrete, Finishing Formed Surfaces, and Finishing Unformed Surfaces. No relaxation of requirements to accommodate flowable concrete will be permitted.

3.5 JOINTS

Joints shall be located and constructed as indicated or approved. Joints not indicated on the drawings shall be located and constructed to minimize the impact on the strength of the structure. In general, such joints shall be located. The perimeters of the slabs shall be free of fins, rough edges, spalling, or other unsightly appearance. Reservoir for sealant for construction and contraction joints in slabs shall be formed to the dimensions shown on the drawings by removing snap-out joint-forming inserts, by sawing sawable inserts, or by sawing to widen the top portion of sawed joints. Joints to be sealed shall be cleaned and sealed as indicated and in accordance with Section 07920 JOINT SEALANTS.

3.5.1 Contraction Joints in Slabs on Grade

Contraction joints shall be located and detailed as shown on the drawings. For saw-cut joints, cutting shall be timed properly with the set of the concrete. Cutting shall be started as soon as the concrete has hardened sufficiently to prevent ravelling of the edges of the saw cut. Cutting shall be completed before shrinkage stresses become sufficient to produce cracking. Reservoir for joint sealant shall be formed as previously specified.

3.6 FINISHING UNFORMED SURFACES

3.6.1 General

In hot weather all requirements of paragraphs Hot Weather Requirements and Prevention of Plastic Shrinkage Cracking shall be met. Unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish, with additional finishing as specified below, and shall be true to the elevation shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings, properly consolidated, and left true and regular. Unless otherwise shown on the drawings, exterior surfaces shall be sloped for drainage, as directed. Where drains are provided, interior floors shall be evenly sloped to the drains. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or "jitterbugs" shall not be used for any surfaces. The dusting of surfaces with dry cement or other materials or the addition of any water during finishing shall not be permitted. If bleedwater is present prior to finishing, the excess water shall be carefully dragged off or removed by absorption with porous materials such as burlap. During finishing operations, extreme care shall be taken to prevent over finishing or working water into the surface; this can cause "crazing" (surface shrinkage cracks which appear after hardening) of the surface. Any slabs with surfaces which exhibit significant crazing shall be removed and replaced. During finishing operations, surfaces shall be checked with a 10 foot straightedge, applied in both directions at regular intervals while the concrete is still plastic, to detect high or low areas.

3.6.2 Rough Slab Finish

As a first finishing operation for unformed surfaces and as final finish for slabs to receive mortar setting beds, the surface shall receive a rough slab finish prepared as follows. The concrete shall be uniformly placed across the slab area, consolidated as previously specified, and then screeded with straightedge strikeoffs immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible. Side forms and screed rails shall be provided, rigidly supported, and set to exact line and grade. Allowable tolerances for finished surfaces apply only to the hardened concrete, not to forms or screed rails. Forms and screed rails shall be set true to line and grade. "Wet screeds" shall not be used.

3.6.3 Floated Finish

Slabs to receive more than a rough slab finish shall next be given a wood float finish. The screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. Then, after the concrete has stiffened so that it will withstand a man's weight without imprint of more than 1/4 inch and the water sheen has disappeared, it shall be floated to a true and even plane free of ridges. Floating shall be performed by use of suitable hand floats or power driven equipment. Sufficient pressure shall be used on the floats to bring a film of moisture to the surface. Hand floats shall be made of wood, magnesium, or aluminum. Lightweight concrete or concrete that exhibits stickiness shall be floated with a magnesium float. Care shall be taken to prevent over-finishing or incorporating water into the surface.

3.6.4 Troweled Finish

Areas as indicated on the drawings to have vinyl tile, carpet or interior surfaces to be left exposed shall be given a trowel finish. After floating is complete and after the surface moisture has disappeared, unformed surfaces shall be steel-troweled to a smooth, even, dense finish, free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. Additional trowelings shall be performed, either by hand or machine until the surface has been troweled 2 times, with waiting period between each. Care shall be taken to prevent blistering and if such occurs, troweling shall immediately be stopped and operations and surfaces corrected. A final hard steel troweling shall be done by hand, with the trowel tipped, and using hard pressure, when the surface is at a point that the trowel will produce a ringing sound. The finished surface shall be thoroughly consolidated and shall be essentially free of trowel marks and be uniform in texture and appearance. The concrete mixture used for troweled finished areas shall be adjusted, if necessary, in order to provide sufficient fines (cementitious material and fine sand) to finish properly.

3.6.5 Non-Slip Finish

Non-slip floors shall be constructed in accordance with the following subparagraphs.

3.6.5.1 Broomed

Areas as indicated on the drawings to be left exposed shall be given a broomed finish. After floating, the surface shall be lightly steel troweled, and then carefully scored by pulling a coarse fiber push-type broom across the surface. Brooming shall be transverse to traffic or at right angles to the slope of the slab. After the end of the curing period, the surface shall be vigorously broomed with a coarse fiber broom to remove all loose or semi-detached particles.

3.7 FLOOR HARDENER

Areas as indicated on the drawings shall be treated with floor hardener. Floor hardener shall be applied after the concrete has been cured and then air dried in accordance with the hardner manfactur's printed instructions. Proprietary hardeners shall be applied in accordance with the manufacturer's instructions. During application, area should be well ventilated. Precautions shall be taken when applying silicofluorides due to the toxicity of the salts. Any compound that contacts glass or aluminum should be immediately removed with clear water.

3.8 EXTERIOR SLAB AND RELATED ITEMS

3.8.1 Pavements

Pavements shall be constructed where shown on the drawings. After forms are set and underlying material prepared as specified, the concrete shall be placed uniformly throughout the area and thoroughly vibrated. As soon as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross section and to such elevation above grade that when consolidated and finished, the surface of the pavement will be at the required elevation. The entire surface shall be tamped with the strike off, or consolidated with a vibrating screed, and this operation continued

until the required compaction and reduction of internal and surface voids are accomplished. Care shall be taken to prevent bringing excess paste to the surface. Immediately following the final consolidation of the surface, the pavement shall be floated longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If necessary, additional concrete shall be placed and screeded, and the float operated until a satisfactory surface has been produced. The floating operation shall be advanced not more than half the length of the float and then continued over the new and previously floated surfaces. After finishing is completed but while the concrete is still plastic, minor irregularities and score marks in the pavement surface shall be eliminated by means of long-handled cutting straightedges. Straightedges shall be 12 feet in length and shall be operated from the sides of the pavement and from bridges. A straightedge operated from the side of the pavement shall be equipped with a handle 3 feet longer than one-half the width of the pavement. The surface shall then be tested for trueness with a 12 foot straightedge held in successive positions parallel and at right angles to the center line of the pavement, and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages of not more than one-half the length of the straightedge. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. The straightedge testing and finishing shall continue until the entire surface of the concrete is true. Before the surface sheen has disappeared and well before the concrete becomes nonplastic, the surface of the pavement shall be given a nonslip sandy surface texture by use of a burlap drag. A strip of clean, wet burlap from 3 to 5 feet wide and 2 feet longer than the pavement width shall be carefully pulled across the surface. Edges and joints shall be rounded with an edger having a radius of 1/8 inch. Curing shall be as specified.

3.8.2 Sidewalks

Concrete shall be 4 inches minimum thickness. Contraction joints shall be provided at 5 feet spaces unless otherwise indicated. Contraction joints shall be cut 1 inch deep with a jointing tool after the surface has been finished. Transverse expansion joints 1/2 inch thick shall be provided at changes in direction and where sidewalk abuts curbs, steps, rigid pavement, or other similar structures. Sidewalks shall be given a lightly broomed finish. A transverse slope of 1/4 inch per foot shall be provided, unless otherwise indicated. Variations in cross section shall be limited to 1/4 inch in 5 feet.

3.8.3 Curbs and Gutters

Concrete shall be formed, placed, and finished by hand using a properly shaped "mule" or constructed using a slipform machine specially designed for this work. Contraction joints shall be cut 3 inches deep with a jointing tool after the surface has been finished. Expansion joints (1/2 inch wide) shall be provided at 100 feet maximum spacing unless otherwise indicated. Exposed surfaces shall be finished using a stiff bristled brush.

3.8.4 Pits and Trenches

Pits and trenches shall be constructed as indicated on the drawings. Bottoms and walls shall be placed monolithically or waterstops and keys, shall be provided as approved.

3.9 CURING AND PROTECTION

3.9.1 General

Concrete shall be cured by an approved method for the period of time given below:

All concrete	7 days

Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, mechanical injury and damage from rain and flowing water for the duration of the curing period. Air and forms in contact with concrete shall be maintained at a temperature above 50 degrees F for the first 3 days and at a temperature above 32 degrees F for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure, and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. Materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat, including welding, shall be permitted near or in direct contact with the concrete at any time. Except as otherwise permitted by paragraph Membrane Forming Curing Compounds, moist curing shall be provided for any areas to receive floor hardener, any paint or other applied coating, or to which other concrete is to be bonded. Concrete containing silica fume shall be initially cured by fog misting during finishing, followed immediately by continuous moist curing. Except for plastic coated burlap, impervious sheeting alone shall not be used for curing.

3.9.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, commencing immediately after finishing. If water or curing materials used stain or discolor concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned as approved. When wooden forms are left in place during curing, they shall be kept wet at all times. If steel forms are used in hot weather, nonsupporting vertical forms shall be broken loose from the concrete soon after the concrete hardens and curing water continually applied in this void. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. The Contractor shall have an approved work system to ensure that moist curing is continuous 24 hours per day.

3.9.3 Impervious Sheeting

Impervious-sheet curing shall only be used on horizontal or nearly horizontal surfaces. Surfaces shall be thoroughly wetted and be completely covered with the sheeting. Sheeting shall be at least 18 inches wider than the concrete surface to be covered. Covering shall be lapped not less than 12 inches and securely weighted down or shall be lapped not less than 4 inches and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings

shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

3.9.4 Cold Weather Curing and Protection

When the daily ambient low temperature is less than 32 degrees F the temperature of the concrete shall be maintained above 40 degrees F for the first seven days after placing. During the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 25 degrees F as determined by suitable temperature measuring devices furnished by the Contractor, as required, and installed adjacent to the concrete surface and 2 inches inside the surface of the concrete. The installation of the thermometers shall be made by the Contractor as directed.

3.10 Nonshrink Grout

Nonshrink grout shall be a ready-mixed material requiring only the addition of water. Water content shall be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength.

3.10.1 Mixing and Placing of Nonshrink Grout

Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified therein. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. The space between the top of the concrete or machinery-bearing surface and the plate shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for completely retaining the grout on all sides and on top and shall be removed after the grout has set. The placed grout shall be carefully worked by rodding or other means to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 65 to 85 degrees F until after setting.

3.11 TESTING AND INSPECTION FOR QUALITY CONTROL

The Contractor shall cooperate with the Owner's independent testing agency who will perform the inspection and tests described below. When, in the opinion of the Owner's Testing Representative, the concreting operation is out of control, concrete placement shall cease and the operation shall be corrected.

3.11.1 Concrete Mixture

a. Air Content Testing. Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of

concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Owner's Representative. Tests shall be made in accordance with ASTM C 231 for normal weight concrete and ASTM C 173/C 173M for lightweight concrete. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the air content and the control chart for range, and for determining need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph Air Entrainment. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line, respectively. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a secondary control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Owner's Representative, and the air content at the mixer controlled as directed.

b. Air Content Corrective Action. Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the secondary control chart for range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted.

c. Slump Testing. In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM C 143/C 143M for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Owner's Representative. Test results shall be plotted on control charts which shall at all times be readily available to the Owner's Representative and shall be submitted weekly.

e. Temperature. The temperature of the concrete shall be measured when compressive strength specimens are fabricated. Measurement shall be in accordance with ASTM C 1064/C 1064M. The temperature shall be reported along with the compressive strength data.

f. Strength Specimens. At least one set of test specimens, consisting of (5) cylinders, shall be made for compressive strength, on each 50 CY concrete mixture placed during the day for each poor. Additional sets of test specimens shall be made, as directed by the Owner's Representative, when the mixture proportions are changed or when low strengths have been detected.

3.11.2 Inspection Before Placing

Foundations, construction joints, forms, and embedded items shall be inspected by the Contractor in sufficient time prior to each concrete placement in order to certify to the Owner's Testing Representative that they are ready to receive concrete. The results of each inspection shall be reported in writing.

3.11.3 Placing

The placing foreman shall supervise placing operations, shall determine that the correct quality of concrete or grout is placed in each location as specified and as directed by the Contracting Officer, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume placed, and method of placement. The placing foreman shall not permit batching and placing to begin until it has been verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

3.11.4 Vibrators

The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete with the tachometer being held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head, and these results averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing. Any vibrator not meeting the requirements of paragraph Consolidation, shall be immediately removed from service and repaired or replaced.

3.11.5 Curing Inspection

a. Moist Curing Inspections. At least once each shift, and not less than twice per day on both work and non-work days, an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.

b. Moist Curing Corrective Action. When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for those areas shall be extended by 1 day.

c. Sheet Curing Inspection. At least once each shift and once per day on non-work days, an inspection shall be made of all areas being cured using impervious sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.

d. Sheet Curing Corrective Action. When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by 1 day.

3.11.6 Cold-Weather Protection

At least once each shift and once per day on non-work days, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

3.11.7 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Owner's Representative has the right to examine all contractor quality control records.

-- End of Section --

SECTION 04200

MASONRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)

ACI 530/530.1	(2002) Building Code Requirements for Masonry Structures and Specifications for Masonry Structures and Commentaries
ACI SP-66	(2004) ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A 153/A 153M	(2004) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 615/A 615M	(2000) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 641/A 641M	(1998) Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 82	(2001) Steel Wire, Plain, for Concrete Reinforcement
ASTM C 1019	(2000b) Sampling and Testing Grout
ASTM C 1072	(2000a) Measurement of Masonry Flexural Bond Strength
ASTM C 1289	(2003) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C 140	(2001ae1) Sampling and Testing Concrete Masonry Units and Related Units
ASTM C 144	(2003) Aggregate for Masonry Mortar
ASTM C 150	(1999a) Portland Cement
ASTM C 207	(1997) Hydrated Lime for Masonry Purposes
ASTM C 216	(2001a) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 270	(2001a) Mortar for Unit Masonry

ASTM C 331	(2005) Standard Specification for Lightweight Aggregates for Concrete Masonry Units
ASTM C 476	(2002) Grout for Masonry
ASTM C 494/C 494M	(2005) Chemical Admixtures for Concrete
ASTM C 55	(2001a) Concrete Brick
ASTM C 578	(2004) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 62	(2001) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 641	(1998e1) Staining Materials in Lightweight Concrete Aggregates
ASTM C 652	(2001a) Hollow Brick (Hollow Masonry Units Made from Clay or Shale)
ASTM C 67	(2003a) Sampling and Testing Brick and Structural Clay Tile
ASTM C 744	(1999) Prefaced Concrete and Calcium Silicate Masonry Units
ASTM C 780	(2002) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C 90	(2001a) Loadbearing Concrete Masonry Units
ASTM C 91	(2001) Masonry Cement
ASTM C 94/C 94M	(2000) Ready-Mixed Concrete
ASTM D 2000	(2003ae1) Rubber Products in Automotive Applications
ASTM D 2240	(2004) Rubber Property - Durometer Hardness
ASTM D 2287	(1996; R 2001) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 119	(2000a) Fire Tests of Building Construction and Materials
ASTM E 514	(2004) Water Penetration and Leakage Through Masonry
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL

PROCEDURES:

SD-02 Shop Drawings

Structural Masonry

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; lintels; and wall openings. Bar splice locations shall be shown. Reinforcement bending details shall conform to the requirements of ACI SP-66.

SD-03 Product Data

Clay or Shale Brick
Insulation
Flashing
Water-Repellant Admixture
Insulation AdhesiveSD-

Location of product manufacture and of harvest/extraction/recovery of primary materials used in product. Designation of the percentages of post-consumer and pre-consumer recycled-content in cement and steel materials. MSDS of all field-applied adhesives used within the building interior, highlighting VOC content.

SD-04 Samples

Pre-faced Concrete Masonry Units (CMU)
Architectual Precast Items
Clay or Shale Brick

Color samples of each unit type and color. Samples shall show the full range of color and texture. Submit sample of colored mortar with applicable masonry unit.

SD-06 Test Reports

Efflorescence Test
Field Testing of Mortar
Field Testing of Grout
Masonry Cement
Fire-rated CMU

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

Special Inspection

Copies of masonry inspector reports.

SD-07 Certificates

Clay or Shale Brick
Concrete Brick
Concrete Masonry Units (CMU)
Control Joint Keys

Anchors, Ties, and Bar Positioners
Expansion-Joint Materials
Joint Reinforcement
Reinforcing Steel Bars and Rods
Masonry Cement
Mortar Coloring
Insulation
Precast Concrete Items
Admixtures for Masonry Mortar
Admixtures for Grout

Certificates of compliance stating that the materials meet the specified requirements.

Insulation

Certificate attesting that the polyurethane or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

SD-08 Manufacturer's Instructions

Masonry Cement

When masonry cement is used, submit the manufacturer's printed instructions on proportions of water and aggregates and on mixing to obtain the type of mortar required.

1.3 SAMPLE MASONRY PANELS

After material samples are approved and prior to starting masonry work, a portable panel of clay or shale brick and sample masonry panels shall be constructed for each type and color of masonry required. At least 48 hours prior to constructing the sample panel or panels, the Contractor shall submit written notification to the Architect. Sample panels shall not be built in, or as part of the structure, but shall be located where directed.

1.3.1 Configuration

Panels shall be L-shaped or otherwise configured to represent all of the wall elements. Panels shall be of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. The minimum size of a straight panel or a leg of an L-shaped panel shall be 8 feet long by 4 feet high.

1.3.2 Composition

Panels shall show full color range, texture, and bond pattern of the masonry work. The Contractor's method for mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work shall be demonstrated during the construction of the panels. Installation or application procedures for anchors, wall ties, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weep holes shall be shown in the sample panels. The panels shall contain a masonry bonded corner that includes a bond beam corner. Panels shall show installation of electrical boxes and conduit. Panels that represent reinforced masonry shall contain a 2 by 2

foot opening placed at least 2 feet above the panel base and 2 feet away from all free edges, corners, and control joints. Required reinforcing shall be provided around this opening as well as at wall corners and control joints.

1.3.3 Construction Method

Where anchored veneer walls are required, the Contractor shall demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Temporary provisions shall be demonstrated to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, the Contractor shall demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. If sealer is specified to be applied to the masonry units, sealer shall be applied to the sample panels. Panels shall be built on a properly designed concrete foundation.

1.3.4 Usage

The completed panels shall be used as the standard of workmanship for the type of masonry represented. Masonry work shall not commence until the sample panel for that type of masonry construction has been completed and approved. Panels shall be protected from the weather and construction operations until the masonry work has been completed and approved. After completion of the work, the sample panels, including all foundation concrete, shall become the property of the Contractor and shall be removed from the construction site.

1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material.

1.4.1 Masonry Units

Concrete masonry units shall be covered or protected from inclement weather. Prefabricated lintels shall be marked on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.4.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

1.5 STRUCTURAL MASONRY

1.5.1 Unit Strength Method

Compute compressive strength of masonry system "Unit Strength Method," ACI 530/530.1. Submit calculations and certifications of unit and mortar strength.

1.6 QUALITY ASSURANCE

1.6.1 Appearance

Bricks shall be manufactured at one time and from the same batch. Blend all brick to produce a uniform appearance when installed. An observable "banding" or "layering" of colors or textures caused by improperly mixed brick is unacceptable.

1.6.2 Testing

Masonry strength shall be determined in accordance with ACI 530/530.1; submit test reports on three prisms as specified in ACI 530/530.1. The cost of testing shall be paid by the Contractor.

1.6.3 Spare Vibrator

Maintain at least one spare vibrator on site at all times.

1.6.4 Bracing and Scaffolding

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by local code.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with the Architects. Materials shall be manufactured and of primary raw materials harvested/extracted/recovered within a 500-mile radius of the Project Site.

2.2 CLAY OR SHALE BRICK

Color range and texture of clay or shale brick shall be as indicated and shall conform to the approved sample. Brick shall conform to ASTM C 62; Grade SW shall be used for brick in contact with earth or grade and for all exterior work and for all nonvertical surfaces. Grade SW. Brick shall be tested for efflorescence. Clay or shale brick units shall be delivered factory-blended to provide a uniform appearance and color range in the completed wall.

2.2.1 Solid Clay or Shale Brick

Solid clay or shale brick shall conform to ASTM C 216, Type FBS. Brick size shall be modular and the nominal size of the brick used shall be4 inches thick, 2-2/3 inches high and 8 inches long (nominal). Minimum compressive strength of the brick shall be 3000 psi.

2.2.2 Hollow Clay or Shale Brick

Hollow clay or shale brick shall conform to ASTM C 652, Type HBS. Brick size shall be as indicated for solid brick. Minimum compressive strength of the brick shall be 3000 psi.

2.3 CONCRETE BRICK

Concrete brick shall conform to ASTM C 55. Concrete brick may be used where necessary for filling out in concrete masonry unit construction.

2.4 CONCRETE MASONRY UNITS (CMU)

Cement shall have a low alkali content and be of one brand. Units shall be of modular dimensions and air, water, or steam cured. Exposed surfaces of units shall be smooth and of uniform texture.

a. Hollow Load-Bearing Units: ASTM C 90, made with lightweight or normal weight aggregate. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.

b. Solid Load-Bearing Units: ASTM C 90, lightweight or medium weight units.

Provide bottom ash for maximum percentage of lightweight aggregate feasible meeting or exceeding ASTM C 331.

2.4.1 Aggregates

Lightweight aggregates shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification.

2.4.2 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used for vertical external corners except at door, window, and louver jambs. Radius of the bullnose shall be 1 inch. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

2.4.2.1 Architectural Units

Units shall have patterned face shell. Face shell pattern shall be filled and ground. Units shall be integrally colored during manufacture. Color shall be as indicated on drawings. Patterned face shell shall be properly aligned in the completed wall.

2.4.2.2 Prefaced Concrete Masonary Units

Prefaced concrete masonry units shall conform to ASTM C 744 using masonry units conforming to ASTM C 90. The facing shall turn over the edges and ends of the unit at least 3/8 inch in the direction of the thickness of the unit to form a lip at least 1/16 inch thick. Variation in color and texture shall not exceed that of the approved samples. All shapes and sizes shall be provided for a complete installation. Bullnose units shall

be used along sills and caps and at vertical external corners including door jambs, window jambs, and other such openings. Radius of the bullnose shall be 1 inch. Base units shall be coved to meet finished floor surfaces where epoky flooring occurs.

2.4.3 Fire-Rated CMU

Concrete masonry units used in fire-rated construction shown on the drawings shall be of minimum equivalent thickness for the fire rating indicated and the corresponding type of aggregates indicated in TABLE I. Units containing more than one of the aggregates listed in TABLE I will be rated on the aggregate requiring the greater minimum equivalent thickness to produce the required fire rating. Construction shall conform to ASTM E 119.

TABLE I

FIRE-RATED CONCRETE MASONRY UNITS

See note (a) below

Aggregate Type	Minimum equivalent thickness inches for fire rating of: 4 hours	3 hours	2 hours
Pumice	4.7	4.0	3.0
Expanded slag	5.0	4.2	3.3
Expanded clay, shale, or slate	5.7	4.8	3.7
Limestone, scoria, cinders or unexpanded slag	5.9	5.0	4.0
Calcareous gravel	6.2	5.3	4.2
Siliceous gravel	6.7	5.7	4.5

(a) Minimum equivalent thickness shall equal net volume as determined in conformance with ASTM C 140 divided by the product of the actual length and height of the face shell of the unit in inches. Where walls are to receive plaster or be faced with brick, or otherwise form an assembly; the thickness of plaster or brick or other material in the assembly will be included in determining the equivalent thickness.

2.5 PRECAST CONCRETE ITEMS

Copings, shall be factory-made units from a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, concrete shall be 5,000 psi minimum conforming to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE using 1/2 inch to No. 4 nominal-size coarse aggregate, and minimum reinforcement shall be the reinforcement required for handling of the units. Clearance of 3/4 inch shall be maintained between reinforcement and faces of units. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 120 psi

for at least 5 hours, the items, after casting, shall be either damp-cured for 24 hours or steam-cured and shall then be aged under cover for 28 days or longer. Cast-concrete members weighing over 80 pounds shall have built-in loops of galvanized wire or other approved provisions for lifting and anchoring. Units shall have beds and joints at right angles to the face, with sharp true arises and shall be cast with drip grooves on the underside where units overhang walls. Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or broken edges. Precast units exposed-to-view shall be of uniform appearance and color. Unless otherwise specified, units shall have a smooth dense finish. Prior to use, each item shall be wetted and inspected for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.

2.6 MORTAR FOR STRUCTURAL MASONRY

ASTM C 270, Type S. Strength (f'm) as indicated. Test in accordance with ASTM C 780. Use Type I portland cement. Do not use admixtures containing chlorides. When structural reinforcement is incorporated, maximum air-content shall be 12 percent in cement-lime mortar and 12 percent in masonry cement mortar.

2.7 MASONRY MORTAR

Mortar Type S and N shall conform to the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate; Type N cement-lime mortar proportions shall be 1 part cement, 1 part lime and 6 parts aggregate. Type N or S mortar shall be used for non-load-bearing, non-shear-wall interior masonry; and exterior masonary veneer; and Type S for remaining masonry work. When masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C 1072. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.7.1 Admixtures for Masonry Mortar

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C.

2.7.2 Colored Mortar

Mortar coloring shall be added to the mortar used for exposed masonry surfaces to produce a uniform color as indicated on drawings. Mortar coloring shall be chemically inert, of finely ground limeproof pigment, and furnished in accurately pre-measured and packaged units that can be added to a measured amount of cement. Compressive strength of colored mortar shall be as indicated.

2.7.3 Hydrated Lime and Alternates

Hydrated lime shall conform to ASTM C 207, Type S. Lime alternates which have a current ICBO, ICBO UBC, Evaluation Report number whose findings state it may be used as an alternate to lime for Type M, S, N, and O mortars will be deemed acceptable provided the user follows the manufacturer's proportions and mixing instructions as set forth in ICBO

report.

2.7.4 Cement

Portland cement shall conform to ASTM C 150, Type I, or II. Masonry cement shall conform to ASTM C 91, Type N S. Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar.

2.7.5 Sand and Water

Sand shall conform to ASTM C 144. Water shall be clean, potable, and free from substances which could adversely affect the mortar.

2.8 WATER-REPELLANT ADMIXTURE

Polymeric type formulated to reduce porosity and water transmission. Construct panels of masonry units conforming to ASTM C 744 and mortar which contain the water-repellant admixture. When tested in accordance with ASTM C 1072, such panels shall have flexural strength not less than that specified or indicated. When tested in accordance with ASTM E 514, panels shall exhibit no water visible on back of test panel and no leaks through the panel after 24 hours, and not more than 25 percent of wall area shall be damp after 72 hours.

2.9 GROUT AND READY-MIXED GROUT

Grout shall conform to ASTM C 476, fine or coarse. Cement used in grout shall have a low alkali content. Grout slump shall be between 8 and 11 inches. Minimum grout strength shall be 2000 psi in 28 days, as tested by ASTM C 1019. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Ready-Mixed grout shall conform to ASTM C 94/C 94M.

2.9.1 Admixtures for Grout

In cold weather, a non-chloride based accelerating admixture may be used subject to approval; accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C. In general, air-entrainment, anti-freeze or chloride admixtures shall not be used except as approved by the Contracting Officer.

2.9.2 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

2.10 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153/A 153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82. Wire ties or anchors in exterior walls shall conform to ASTM A 641/A 641M. Joint reinforcement in interior walls, and in exterior or interior walls exposed to moist environment shall conform to ASTM A 641/A 641M; coordinate with paragraph JOINT REINFORCEMENT below.

Anchors and ties shall be sized to provide a minimum of 5/8 inch mortar cover from either face.

2.10.1 Wall Ties

Wall ties shall be rectangular-shaped fabricated of 3/16 inch diameter zinc-coated steel wire. Rectangular wall ties shall be no less than 4 inches wide. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT. Adjustable type wall ties, if approved for use, shall consist of two essentially U-shaped elements fabricated of 3/16 inch diameter zinc-coated steel wire. Adjustable ties shall be of the double pintle to eye type and shall allow a maximum of 1/2 inch eccentricity between each element of the tie. Play between pintle and eye opening shall be not more than 1/16 inch. The pintle and eye elements shall be formed so that both can be in the same plane.

2.10.2 Adjustable Anchors

Adjustable anchors shall be 3/16 inch diameter steel wire, triangular-shaped. Anchors attached to steel shall be 5/16 inch diameter steel bars placed to provide 1/16 inch play between flexible anchors and structural steel members. Spacers shall be welded to rods and columns. Equivalent welded-on steel anchor rods or shapes standard with the flexible-anchor manufacturer may be furnished when approved. Welds shall be cleaned and given one coat of zinc-rich touch up paint.

2.10.3 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

2.11 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153/A 153M, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 5/8 inch cover from either face. The distance between crosswires shall not exceed 16 inches. Joint reinforcement for straight runs shall be furnished in flat sections not less than 10 feet long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features.

2.12 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615/A 615M, Grade 60. Reinforcement steel shall have a recycled content of 95 percent or more of which minimum 60 percent shall be post-consumer and the remainder may be pre-consumer.

2.13 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000or

polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch. The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 30 degrees F after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D 2240.

2.14 INSULATION

2.14.1 Rigid Board-Type Insulation

Rigid board-type insulation shall be extruded polystyrene, polyurethane, or polyisocyanurate. Polystyrene shall conform to ASTM C 578. Polyisocyanurate shall conform to ASTM C 1289, Type I, Class 1 or 2, faced with aluminum foil on both sides of the foam. The insulation shall be a standard product and shall be marked with not less than the manufacturer's trademark or name, the specification number, the permeance and R-values. Provide insulation containing the maximum recycled content feasible.

2.14.1.1 Insulation Thickness and Air Space

The cavity space shall allow for a maximum insulation thickness of 1.5 inches, and a minimum air space of 1.25 inch.

2.14.1.2 Aged R-Value

The insulation shall provide a minimum aged R-value of 10.8 for the overall thickness. The aged R-value shall be determined at 75 degrees F in accordance with the appropriate referenced specification. The stated R-value of the insulation shall be certified by an independent testing laboratory or certified by an independent Registered Professional Engineer if tests are conducted in the manufacturer's laboratory.

2.14.2 Insulation Adhesive

Insulation adhesive shall be specifically prepared to adhere the insulation to the masonry and, where applicable, to the thru-wall flashing. The adhesive shall not deleteriously affect the insulation, and shall have a record of satisfactory and proven performance for the conditions under which to be used. Adhesive shall have a VOC content not more than 50 g/l.

2.14.3 Foam-In-Place Insulation

Foam-in-place insulation shall be a urea-formaldehyde, 3-component, site manufactured, conforming to ASTM E 84 for a flame spread of 25 or less and a smoke developed ratio of less than 450. Cured foam shall have a minimum R-value of 4 per inch of thickness with approximately 2 percent shrinkage and a density of 0.8 lb/ft^3.

2.15 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07920 JOINT SEALANTS.

2.16 THROUGH WALL FLASHING

Coordinate with Section 07600 FLASHING AND SHEET METAL. Provide one of the following types except that flashing indicated to terminate in reglets shall be metal or coated-metal flashing .

a. Coated-Copper Flashing: 7 ounce, electrolytic copper sheet, uniformly coated on both sides with acidproof, alkaliproof, elastic bituminous compound. Factory apply coating to a weight of not less than 6 ounces/square foot (approximately 3 ounces/square foot on each side).

b. Reinforced Membrane Flashing: Polyester film core with a reinforcing fiberglass scrim bonded to one side. The membrane shall be impervious to moisture, flexible, and not affected by caustic alkalis. The material, after being exposed for not less than 1/2 hour to a temperature of 32 degrees F, shall show no cracking when, at that temperature, it is bent 180 degrees over a 1/16 inch diameter mandrel and then bent at the same point over the same size mandrel in the opposite direction 360 degrees.

2.17 WEEP HOLE VENTILATORS

Weephole ventilators shall be prefabricated aluminum, plastic or wood blocking sized to form the proper size opening in head joints. Provide aluminum and plastic inserts with grill or screen-type openings designed to allow the passage of moisture from cavities and to prevent the entrance or insects. Ventilators shall be sized to match modular construction with a standard 3/8 inch mortar joint.

PART 3 EXECUTION

Recycle or salvage waste steel and masonry units in accordance with Division 1 "Construction Waste Management" requirements.

3.1 PREPARATION

Prior to start of work, masonry inspector shall verify the applicable onditions as set forth in ACI 530/530.1, inspection. The Owner's Representative will serve as inspector or will select a masonry inspector.

3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent or the ambient air temperature exceeds 90 degrees F and the wind velocity is more than 8 mph. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

3.1.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 40 degrees F or temperature of masonry units is below 40 degrees F, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following

precautions shall be taken during all cold weather erection.

3.1.2.1 Protection

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

a. Air Temperature 40 to 32 Degrees F. Sand or mixing water shall be heated to produce mortar temperatures between 40 and 120 degrees F.

b. Air Temperature 32 to 25 Degrees F. Sand and mixing water shall be heated to produce mortar temperatures between 40 and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing.

c. Air Temperature 25 to 20 Degrees F. Sand and mixing water shall be heated to provide mortar temperatures between 40 and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 15 mph.

d. Air Temperature 20 Degrees F and below. Sand and mixing water shall be heated to provide mortar temperatures between 40 and 120 degrees F. Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees F. Temperature of units when laid shall not be less than 20 degrees F.

3.1.2.2 Completed Masonry and Masonry Not Being Worked On

a. Mean daily air temperature 40 to 32 degrees F. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.

b. Mean daily air temperature 32 to 25 degrees F. Masonry shall be completely covered with weather-resistant membrane for 24 hours.

c. Mean Daily Air Temperature 25 to 20 degrees F. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.

d. Mean Daily Temperature 20 degrees F and Below. Masonry temperature shall be maintained above 32 degrees F for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

3.1.3 Stains

Potect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

3.1.4 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing

as required.

3.1.5 Surfaces

Surfaces on which masonry is to be placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 1/8 inch. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

3.2 LAYING MASONRY UNITS

Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Concrete Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 1/2 inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below. In double wythe construction, the inner wythe may be brought up not more than 16 inches ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 8 inches.

3.2.1 Forms and Shores

Provide bracing and scaffolding as required. Design bracing to resist wind pressure as required by local codes. Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

3.2.2 Reinforced Concrete Masonry Units Walls

Where vertical reinforcement occurs, fill cores solid with grout. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Embed the adjacent webs in mortar to prevent leakage of grout. Remove mortar fins protruding from joints before placing grout. Minimum clear dimensions of vertical cores shall be 2 by 3 inches. Position reinforcing accurately as indicated before placing grout. As masonry work progresses, secure vertical reinforcing in place at vertical intervals not to exceed 160 bar diameters. Use puddling rod or vibrator to consolidate the grout. Minimum clear distance between masonry and vertical

reinforcement shall be not less than 1/2 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together.

3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

3.2.4 Clay or Shale Brick Units

Brick facing shall be laid with the better face exposed. Brick shall be laid in Flemish bond with each course bonded at corners, unless otherwise indicated. Provide headers of contrasting color. Corners shall be Dutch-type without headers. Molded brick shall be laid with the frog side down. Brick that is cored, recessed, or has other deformations may be used in sills, treads, soldier courses, except where deformations will be exposed to view.

3.2.4.1 Wetting of Units

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 1 gram per minute per square inch of bed surface shall be in conformance with ASTM C 67. The method of wetting shall ensure that each unit is nearly saturated but surface dry when laid. Test clay or shale brick daily on the job, prior to laying, as follows: Using a wax pencil, draw a circle the size of a quarter on five randomly selected bricks. Apply 20 drops of water with a medicine dropper to the surface within the circle on each brick. If the average time that the water is completely absorbed in the five bricks is less than 1-1/2 minutes, wet bricks represented by the five bricks tested.

3.2.4.2 Solid Units

Bed, head, and collar joints shall be completely filled with mortar.

3.2.4.3 Hollow Units

Hollow units shall be laid as specified for concrete masonry units.

3.2.4.4 Brick-Faced Walls

For brick-faced walls bond brick in the pattern as indicated on the drawings. Provide additional bonding ties spaced not more than 3 feet apart around the perimeter of and within 12 inches of all openings.

a. Collar Joints: Fill collar joints solid with mortar as each course of brick is laid. Do not disturb units in place.

b. Brick Sills: Provide shaped sill units on edge, slope, and project not less than 1/2 inch beyond the face of the wall to form a wash and drip. Fill all joints solidly with mortar and tool.

3.2.4.5 Cavity Walls

Provide a continuous cavity as indicated. Securely tie the two wythes together with horizontal joint reinforcement. Bevel mortar beds away from cavity to prevent projection into cavity when bricks are shoved in place. Keep cavities clear and clean of mortar droppings. Provide weep holes of open head joints spaced 24 inches o.c. wherever the cavity is interrupted. Cavity face of interior wythe shall be dampproofed in accordance with Section 07112 BITUMINOUS DAMPPROOFING.

3.2.4.6 Arch Detailing

Provide rubbed brick arches by field cutting the faces of the brick and cutting edges to taper the units and form the arch as shown on drawings.

3.2.4.7 Brick Veneer

Provide a continuous cavity as indicated. Install brick veneer after sheathing, masonry anchors, and flashing have been installed to the cold-formed steel framing system. Care shall be provided to avoid damaging the moisture barrier. Damaged moisture barrier and flashing shall be repaired or replaced before brick veneer is installed. Means shall be provided to keep cavities clean and clear of mortar droppings.

3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II

TOLERANCES

Variation from the plumb in the lines and surfaces of columns, walls and arises	
In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch
Variations from the plumb for external corners, expansion joints, and other conspicuous lines	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch
Variation from level for bed joints and top surfaces of bearing walls	
In 10 feet	1/4 inch
In 40 feet or more	1/2 inch
Variations from horizontal lines	
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch
Variations in cross sectional dimensions of columns and in thickness of walls	
Minus	1/4 inch
Plus	1/2 inch

3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.7.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall. Joints in unparged masonry walls below grade shall be pointed tight. Flush joints for architectural units, such as fluted units, shall completely fill both the head and bed joints.

3.2.7.2 Tooled Joints

Joints in exposed exterior masonry surfaces shall be tooled with a "grapevine" joint. Interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed.

3.2.7.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch.

3.2.8 Joint Widths

Joint widths shall be as follows:

3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have 3/8 inch joints, except for prefaced concrete masonry units.

3.2.8.2 Prefaced Concrete Masonry Units

Prefaced concrete masonry units shall have a joint width of 3/8 inch wide on unfaced side and not less than 3/16 inch nor more than 1/4 inch wide on prefaced side.

3.2.8.3 Brick

Brick joint widths shall be the difference between the actual and nominal dimensions of the brick in either height or length. Brick expansion joint widths shall be as shown. Brick joints in arches shall be as tight as practicable.

3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Toothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

3.2.11 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and

intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.2.12 Partitions

Where suspended ceilings on both sides of partitions are indicated, the partitions other than those shown to be continuous may be stopped approximately 4 inches above the ceiling level. An isolation joint shall be placed in the intersection between partitions and structural or exterior walls as shown. Interior partitions having masonry walls over 4 inches thick shall be tied together with joint reinforcement. Partitions containing joint reinforcement shall be provided with prefabricated pieces at corners and intersections or partitions.

3.3 ANCHORED VENEER CONSTRUCTION

The inner and outer wythes shall be completely separated by a continuous airspace as shown on the drawings. Both the inner and the outer wythes shall be laid up together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up together, through-wall flashings shall be protected from damage until they are fully enclosed in the wall. The airspace between the wythes shall be kept clear and free of mortar droppings by temporary wood strips laid on the wall ties and carefully lifted out before placing the next row of ties. A drainage material shall be placed behind the weep holes in the cavity to a minimum depth of10 inches of drainage material to keep mortar droppings from plugging the weep holes.

3.4 WEEP HOLES

Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior. Weep holes shall be open head joints at 24 inches o.c. Weep holes shall be provided not more than 24 inches on centers in mortar joints of the exterior wythe above wall flashing, over foundations, bond beams, and any other horizontal interruptions of the cavity.

3.5 COMPOSITE WALLS

Masonry wythes shall be tied together with joint reinforcement or with unit wall ties. The facing wythe shall be anchored or tied to the backup at a maximum spacing of 16 inches on center vertically and 24 inches on center horizontally. Unit ties shall be spaced not over 24 inches on centers horizontally, in courses not over 16 inches apart vertically, staggered in alternate courses. Ties shall be laid not closer than 5/8 inch to either masonry face. Ties shall not extend through control joints. Collar joints between masonry facing and masonry backup shall be filled solidly with grout.

3.6 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been

used within 2-1/2 hours after mixing shall be discarded.

3.7 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 2 inches of tops of walls.

3.7.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

3.7.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement.

3.8 JOINT REINFORCEMENT INSTALLATION

Joint reinforcement shall be installed at 16 inches on center or as indicated. Reinforcement shall be lapped not less than 6 inches. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 5/8 inch cover to either face of the unit.

3.9 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

3.9.1 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

3.9.2 Grout Holes and Cleanouts

3.9.2.1 Grout Holes

Grouting holes shall be provided in slabs, spandrel beams, and other in-place overhead construction. Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Additional openings spaced not more than 16 inches on centers shall be provided where grouting of all hollow unit masonry is indicated. Openings shall not be less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, grouting holes shall be plugged and finished to match surrounding surfaces.

3.9.2.2 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet. Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 3 by 4 inch openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.9.2.3 Cleanouts for Solid Unit Masonry Construction

Cleanouts for construction of walls consisting of a grout filled cavity between solid masonry wythes shall be provided at the bottom of every pour by omitting every other masonry unit from one wythe. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanout holes shall not be plugged until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.9.3 Grouting Equipment

3.9.3.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

3.9.3.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

3.9.4 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 5 feet in height. High-lift grout methods shall be used on pours exceeding 5 feet in height.

3.9.4.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 1/2 inch into the grout space shall be removed before beginning the grouting operation. Grout pours 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

3.9.4.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 1/4 inch into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 4 feet in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 12 to 18 inches into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (feet) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (in.) (1,2) Multiwythe Masonry (3)	Hollow-unit Masonry
1	Fine	Low Lift	3/4	1-1/2 x 2
5	Fine	Low Lift	2	2 x 3
8	Fine	High Lift	2	2 x 3
12	Fine	High Lift	2-1/2	2-1/2 x 3
24	Fine	High Lift	3	3 x 3
1	Coarse	Low Lift	1-1/2	1-1/2 x 3
5	Coarse	Low Lift	2	2-1/2 x 3
8	Coarse	High Lift	2	3 x 3
12	Coarse	High Lift	2-1/2	3 x 3
24	Coarse	High Lift	3	3 x 4

Notes:

(1) The actual grout space or cell dimension must be larger than the sum of the following items:
a) The required minimum dimensions of total clear areas given in the table above;
b) The width of any mortar projections within the space;
c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.

(2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 3/4 inch or greater in width.

(3) For grouting spaces between masonry wythes.

(4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

3.10 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 1/2 inch shall be maintained between reinforcement and interior faces of units.

3.11 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using sash jamb units with control joint key in accordance with the details shown on the drawings. Sash jamb units shall have a 3/4 by 3/4 inch groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams.

This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. Exposed interior control joints shall be raked to a depth of 1/4 inch. Concealed control joints shall be flush cut.

3.12 BRICK EXPANSION JOINTS AND CONCRETE MASONRY VENEER JOINTS

Brick expansion joints and concrete masonry veneer joints shall be provided and constructed as shown on the drawings. Joints shall be kept free of mortar and other debris.

3.13 SHELF ANGLES

Shelf angles shall be adjusted as required to keep the masonry level and at the proper elevation. Shelf angles shall be galvanized. Shelf angles shall be provided in sections not longer than 10 feet and installed with a 1/4 inch gap between sections. Shelf angles shall be mitered and welded at building corners with each angle not shorter than 4 feet, unless limited by wall configuration.

3.14 LINTELS

3.14.1 Masonry Lintels

Masonry lintels shall be constructed with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 1/2 inch above the bottom inside surface of the lintel unit.

3.14.2 Steel Lintels

Steel lintels shall be as shown on the drawings. Lintels shall be set in a full bed of mortar with faces plumb and true. Steel and precast lintels shall have a minimum bearing length of 8 inches unless otherwise indicated on the drawings.

3.15 SILLS AND COPINGS

Sills and copings shall be set in a full bed of mortar with faces plumb and true.

3.16 INSULATION

Anchored veneer walls shall be insulated, where shown, by installing board-type insulation on the cavity side of the inner wythe and filling open cores with foam-in-place insulation. Board type insulation shall be applied directly to the masonry or thru-wall flashing with adhesive. Insulation shall be neatly fitted between obstructions without impaling of insulation on ties or anchors. The insulation shall be applied in parallel courses with vertical joints breaking midway over the course below and shall be applied in moderate contact with adjoining units without forcing, and shall be cut to fit neatly against adjoining surfaces. Foam shall be installed from the top of the wall cavity by installing an extension tube into the core and with drawing the tube as the foam fills the core. Mortar shall have cured and the cores shall be dry prior to

installation. After foam sets, remove excess from top of wall and dispose. Protect foamed areas from excess moisture for 24 hours following installation.

3.17 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.17.1 Concrete Masonry Unit and Concrete Brick Surfaces

Exposed concrete masonry unit and concrete brick surfaces shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.17.2 Clay or Shale Brick Surfaces

Exposed clay or shale brick masonry surfaces shall be cleaned as necessary to obtain surfaces free of stain, dirt, mortar and grout daubs, efflorescence, and discoloration or scum from cleaning operations. After cleaning, the sample panel of similar material shall be examined for discoloration or stain as a result of cleaning. If the sample panel is discolored or stained, the method of cleaning shall be changed to assure that the masonry surfaces in the structure will not be adversely affected. The exposed masonry surfaces shall be water-soaked and then cleaned with a solution proportioned 1/2 cup trisodium phosphate and 1/2 cup laundry detergent to one gallon of water or cleaned with a proprietary masonry cleaning agent specifically recommended for the color and texture by the clay products manufacturer. The solution shall be applied with stiff fiber brushes, followed immediately by thorough rinsing with clean water. Proprietary cleaning agents shall be used in conformance with the cleaning product manufacturer's printed recommendations. Efflorescence shall be removed in conformance with the brick manufacturer's recommendations.

3.18 BEARING PLATES

Bearing plates for beams and similar structural members shall be set to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.19 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the

wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

3.20 TEST REPORTS

3.20.1 Field Testing of Mortar

At least three specimens of mortar shall be taken each day. A layer of mortar 1/2 to 5/8 inch thick shall be spread on the masonry units and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

3.20.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 2000 psi at 28 days.

3.20.3 Efflorescence Test

Brick which will be exposed to weathering shall be tested for efflorescence. Tests shall be scheduled far enough in advance of starting masonry work to permit retesting if necessary. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Units meeting the definition of "effloresced" will be subject to rejection.

-- End of Section --

SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 316	(1989) ASD Manual of Steel Construction
AISC 317	(1992) Manual of Steel Construction, Volume II, Connections

ASTM INTERNATIONAL (ASTM)

ASTM A 36/A 36M	(2000) Carbon Structural Steel
ASTM A 53	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 123/A 123M	(1997e1) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2004) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(2000) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(2004b) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 500	(2003a) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 563	(2004) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 572/A 572M	(2001) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 780	(2001) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 992/A 992M	(2003) Structural Steel Shapes
ASTM C 827	(2001; Rev A) Change in Height at Early Ages of Cylindrical Specimens from

	Cementitious Mixtures
ASTM C 1107	(2002) Packaged Dry, Hydraulic-Cement Grout(Nonshrink)
ASTM F 436	(2003) Hardened Steel Washers
ASTM F 844	(2000) Washers, Steel, Plain (Flat), Unhardened for General Use

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2004) Structural Welding Code - Steel

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3	(1982; R 2000) Power Tool Cleaning
SSPC SP 6	(2000) Commercial Blast Cleaning
SSPC Paint 25	(1997; R 2000) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II
SSPC PA 1	(2000) Shop, Field, and Maintenance Painting
SSPC PS 13.01	(1982; R 2000) Epoxy-Polyamide Painting System

1.2 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD- 03 Product Data

Location(s) of product manufacture and of harvested/extracted/recovery or primary materials used in product. MSDS of all field-applied adhesives used within the building interior, highlighting VOC content. Composite wood and plywood manufacturer's product data for each composite wood and plywood product used indicating that bonding agent used contains no urea formaldehyde. Forest Stewardship Council (FSC) certification for all sustainable harvested wood, including chain of custody number.

SD-07 Certificates

Steel

Bolts, nuts, and washers

Galvanizing

1.3 QUALITY ASSURANCE

PART 2 PRODUCTS

2.1 STEEL

a. Provide steel manufactured and of primary mateirals harvested/extracted/recovered within a 500-mile radius of the Project Site.

b. Provide structural steel members containing a recycled content of 95 percent or more, of which minimum 60 percent shall be post-consumer and the remainder may be pre-consumer. Steel decking shall have a minimum recycled content on 50 percent, including 25 percent post-consumer content.

2.1.1 Structural Steel

ASTM A 36/A 36M.

2.1.2 High-Strength Structural Steel

2.1.2.1 Low-Alloy Steel

ASTM A 572/A 572M, Grade 50. ASTM A 992/A 992M Grade 50.

2.1.3 Structural Shapes for Use in Building Framing

Wide flange shapes, ASTM A 992/A 992M.

2.1.4 Structural Steel Tubing

ASTM A 500, Grade B

2.1.5 Steel Pipe

ASTM A 53, Type E or S, Grade B, weight class STD (Standard).

2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

2.2.1 Bolts

ASTM A 307, Grade A; ASTM A 325, Type 1. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.2.2 Nuts

ASTM A 563, Grade and Style for applicable ASTM bolt standard recommended.

2.2.3 Washers

ASTM F 844 washers for ASTM A 307 bolts; ASTM F 436 washers for ASTM A 325 bolts.

2.2.4 Foundation Anchorage

2.2.4.1 Anchor Rods

ASTM F 1554, grade 36, headed or threaded and nutted type, hot-dipped galvanized.

2.2.4.2 Anchor Nuts

ASTM A 563, Grade A, hex style, hot-dipped galvanized.

2.2.4.3 Anchor Washers

ASTM F 844, hot-dipped galvanized.

2.3 STRUCTURAL STEEL ACCESSORIES

2.3.1 Welding Electrodes and Rods

AWS D1.1.

2.3.2 Non-Shrink Grout

ASTM C 1107, with no ASTM C 827 shrinkage. Grout shall be nonmetallic.

2.4 SHOP PRIMER

SSPC Paint 25, (alkyd primer) or SSPC PS 13.01 epoxy-polyamide, green primer (Form 150) type 1, except provide a Class B coating in accordance with AISC 316 and AISC 317 for slip critical joints. Primer shall conform to Federal, State, and local VOC regulations. If flash rusting occurs, re-clean the surface prior to application of primer.

2.5 GALVANIZING

ASTM A 123/A 123M or ASTM A 153/A 153M, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.6 FABRICATION

2.6.1 Shop Primer

Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, or surfaces within 0.5 inch of the toe of the welds prior to welding prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless approved otherwise by the Owner's Representative.

2.6.1.1 Cleaning

SSPC SP 6, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.6.1.2 Primer

Apply primer to a minimum dry film thickness of 2.0 mil except provide the Class B coating for slip critical joints in accordance with the coating manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC 316. Fabrication and assembly shall be done in the shop to the greatest extent possible.

3.2 INSTALLATION

3.3 ERECTION

After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.3.1 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

3.4 Bolts

ASTM A 307 and ASTM A 325 bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench.

3.5 WELDING

AWS D1.1/D1.1M

3.6 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.6.1 Field Priming

Field priming of steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

3.7 GALVANIZING REPAIR

Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using ASTM A 780 zinc

rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

-- End of Section --

SECTION 06100

ROUGH CARPENTRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN FOREST & PAPER ASSOCIATION (AF&PA)

AF&PA T10	(2001) Wood Frame Construction Manual for One- and Two-Family Dwellings
AF&PA T101	(2001) National Design Specification (NDS)for Wood Construction

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.2.1	(1996; Errata 2003) Square and Hex Bolts and Screws Inch Series
ANSI B18.5.2.1M	(1981; R 1995) Metric Round Head Short Square Neck Bolts
ANSI B18.6.1	(1981; R 1997) Wood Screws (Inch Series)

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C1	(2000) All Timber Products - Preservative Treatment by Pressure Processes
AWPA C2	(2001) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA C28	(1999) Standard for Preservative Treatment of Structural Glued Laminated Members and Lamination Before Gluing of Southern Pine, Coastal Douglas Fir, Hemfir and Western Hemlock by Pressure Processes
AWPA C9	(2000) Plywood - Preservative Treatment by Pressure Processes
AWPA M2	(2001) Standard for Inspection of Treated Wood Products
AWPA M6	(1996) Brands Used on Forest Products

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA E30	(2003) Engineered Wood Construction Guide

ASME INTERNATIONAL (ASME)

ASME B18.2.2	(1987; R 1999) Square and Hex Nuts
ASME B18.5.2.2M	(1982; R 2000) Metric Round Head Square Neck Bolts

ASTM INTERNATIONAL (ASTM)

ASTM A 307	(2000) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 687	(1993) High-Strength Nonheaded Steel Bolts and Studs
ASTM F 1667	(2001a) Driven Fasteners: Nails, Spikes, and Staples
ASTM F 547	(2001) Nails for Use with Wood and Wood-Base Materials

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2003) International Building Code

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003	(2002) Standard Grading Rules for Southern Pine Lumber

TRUSS PLATE INSTITUTE (TPI)

TPI HIB	(1991) Commentary and Recommendations for Handling, Installing and Bracing Metal Plate Connected Wood Trusses

U.S. DEPARTMENT OF COMMERCE (DOC)

PS1	(1995) Construction and Industrial Plywood (APA V995)
PS20	(1999) American Softwood Lumber Standard

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD- 03 Product Data

Location(s) of product manufacture and of harvest/ extraction/ recovery of primary materials used in product. MSDS of all field-applied adhesives used within the building interior, highlighting VOC content. Composite wood and plywood manufacturer's product data for each composite wood and plywood product used indicating that bonding agent used contains no urea formaldehyde. Forest Stewardship Council (FSC) certification for all sustainably harvested wood, including chain of custody number.

1.3 DELIVERY AND STORAGE

Deliver materials to the site in an undamaged condition. Store materials off the ground to provide proper ventilation, with drainage to avoid standing water, and protection against ground moisture and dampness. Store materials with a moisture barrier at both the ground level and as a cover forming a well ventilated enclosure. Remove defective and damaged materials and provide new materials.

1.4 GRADING AND MARKING

1.4.1 Lumber

Mark each piece of framing and board lumber or each bundle of small pieces of lumber with the grade mark of a recognized association or independent inspection agency. Such association or agency shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. Surfaces that are to be exposed to view shall not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

1.4.2 Plywood

Mark each sheet with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The mark shall identify the plywood by species group or span rating, exposure durability classification, grade, and compliance with PS1.Surfaces that are to be exposed to view shall not bear grademarks or other types of identifying marks.

1.4.3 Structural-Use

Mark each panel with the mark of a recongnized association or independent inspection agency that maintains continuing control over the quality of the panel. The mark shall insicate end use, span rating, and exposure durability classification.

1.4.4 Preservative-Treated Lumber and Plywood

The Contractor shall be responsible for the quality of treated wood products. Each treated piece shall be inspected in accordance with AWPA M2 and permanently marked or branded, by the producer, in accordance with AWPA M6. The Contractor shall provide the Owner with the inspection report of an approved independent inspection agency that offered products comply with applicable AWPA Standards. The appropriate Quality Mark on each piece will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

1.4.5 Hardboard, Gypsum Board, and Fiberboard

Mark each sheet or bundle to identify the standard under which the material is produced and the producer.

1.5 SIZES AND SURFACING

PS20 for dressed sizes of yard and structural lumber. Lumber shall be surfaced four sides. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced. Other

measurements are IP or SI standard.

1.6 MOISTURE CONTENT

Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products shall be as follows at the time of delivery to the job site:

a. Framing lumber and boards - 19 percent maximum

b. Timbers 5 inches and thicker - 25 percent maximum

d. Materials other than lumber - Moisture content shall be in accordance with standard under which the product is produced

1.7 PRESERVATIVE TREATMENT

Treat lumber and timber in accordance with AWPA C1 and AWPA C2, and plywood in accordance with AWPA C1 and AWPA C9. Treat structural glued laminated timber in accordance with AWPA C1 and AWPA C28.

a. 0.25 pcf intended for above ground use.

b. 0.40 pcf intended for ground contact and fresh water use. All wood shall be air or kiln dried after treatment. Specific treatments shall be verified by the report of an approved independent inspection agency, or the AWPA Quality Mark on each piece. Brush coat areas that are cut or drilled after treatment with either the same preservative used in the treatment or with a 2 percent copper naphthenate solution. The following items shall be preservative treated:

1. Wood members that are in contact with water.

2. Exterior wood steps, platforms, and railings.

3. Wood sills, soles, plates, furring, and sleepers that are less than 24 inches from the ground, furring and nailers that are set into or in contact with concrete or masonry.

1.8 QUALITY ASSURANCE

1.8.1 Drawing Requirements

For fabricated structural members, trusses, qlu-lam members, indicate materials, details of construction, methods of fastening, and erection details. Include reference to design criteria used and manufacturers design calculations. Submit drawings for all proposed modifications of structural members. Do not proceed with modifications until the submittal has been approved.

1.8.2 Data Required

Submit calculations and drawings for all proposed modifications of structural members. Do not proceed with modifications until the submittal has been approved.

1.8.3 Certificates of Grade

Submit certificates attesting that products meet the grade requirements specified in lieu of grade markings where appearance is important and grade marks will deface material.

PART 2 PRODUCTS

2.1 LUMBER

2.1.1 Framing Lumber

Framing lumber such as studs, plates, caps, collar beams, cant strips, bucks, sleepers, nailing strips, and nailers and board lumber such as subflooring and wall and roof sheathing shall be one of the species listed in the table below. Minimum grade of species shall be as listed.

Table of Grades for Framing and Board Lumber

Grading Rules	Species	Framing
SPIB 1003 standard grading rules	Southern Pine	Structural Light Framing Boards No. 2, unless otherwise indicated

Provide framing lumber manufactured and harvested/ extracted/ recovered within a 500-mile radius of the Project Site. Give preference to sustainably harvested wood bearing the FSC certification.

2.2 PLYWOOD

PS1 Provide plywood manufactured and of primary raw materials harvested/ extracted/ recovered within a 500-mile radius of the Project Site. Give preference to sustainably harvested wood bearing the FSC certification. Ensure plywood bonding agent contains no urea formaldehyde.

2.2.1 Roof Sheathing

2.2.1.1 Plywood

C-D Grade, Exposure 1, with an Identification Index of not less than 48/24.

2.2.2 Other Uses

2.2.2.1 Plywood

Plywood for Communications Backboards.

Plywood shall conform to PS1, B-C grade with exterior glue, 11/32 inch thick, 4 feet wide.

2.3 OTHER MATERIALS

2.3.1 Building Paper

Type I, Grade D, Style 1.

2.3.2 Miscellaneous Wood Members

2.3.2.1 Nonstress Graded Members

Members shall include bridging, corner bracing, furring, grounds, and nailing strips. Members shall be in accordance with TABLE I for the species used. Sizes shall be as follows unless otherwise shown:

Member	Size (inch)
Bridging	1 x 3 or 1 x 4 for use between members 2 x 12 and smaller; 2 x 4 for use between members larger than 2 x 12.
Corner bracing	1 x 4.
Furring	1 x 3.
Nailing strips	1 x 3 or 1 x 4 when used as shingle base or interior finish, otherwise 2 inch stock.

2.3.2.2 Blocking

Blocking shall be standard or number 2 grade.

2.3.2.3 Rough Bucks and Frames

Rough bucks and frames shall be straight standard or number 2 grade.

2.4 ROUGH HARDWARE

Unless otherwise indicated or specified, rough hardware shall be of the type and size necessary for the project requirements. Sizes, types, and spacing of fastenings of manufactured building materials shall be as recommended by the product manufacturer unless otherwise indicated or specified. Rough hardware exposed to the weather or embedded in or in contact with preservative treated wood, exterior masonry, or concrete walls or slabs shall be zinc-coated.

2.4.1 Bolts, Nuts, Studs, and Rivets

ANSI B18.2.1, ANSI B18.5.2.1M, ASME B18.5.2.2M, ASME B18.2.2, and ASTM A 687.

2.4.2 Anchor Bolts

ASTM A 307, size as indicated, complete with nuts and washers.

2.4.3 Lag Screws and Lag Bolts

ANSI B18.2.1.

2.4.4 Wood Screws

ANSI B18.6.1.

2.4.5 Nails

ASTM F 547, size and type best suited for purpose. For sheathing length of nails shall be sufficient to extend 1 inch into supports. In general, 8-penny or larger nails shall be used for nailing through 1 inch thick lumber and for toe nailing 2 inch thick lumber; 16-penny or larger nails shall be used for nailing through 2 inch thick lumber. Nails used with treated lumber and sheathing shall be stainless steel. Nailing shall be in accordance with the recommended nailing schedule contained in AF&PA T10. Where detailed nailing requirements are not specified, nail size and spacing shall be sufficient to develop an adequate strength for the connection. The connection's strength shall be verified against the nail capacity tables in AF&PA T101. Reasonable judgment backed by experience shall ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector shall be used.

2.4.6 Wire Nails

ASTM F 1667.

2.4.7 Clip Angles

Steel, 3/16 inch thick, size as indicated best suited for intended use; or zinc-coated steel or iron commercial clips designed for connecting wood members.

2.4.8 Panel Edge Clips

Extruded aluminum or galvanized steel, H-shaped clips to prevent differential deflection of roof sheathing.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to AF&PA T10 unless otherwise indicated or specified. Fit framing lumber and other rough carpentry, set accurately to the required lines and levels, and secure in place in a rigid manner. Do not splice framing members between bearing points. Set joists, rafters, and purlins with their crown edge up. Frame members for the passage of pipes, conduits, and ducts. Do not cut or bore structural members for the passage of ducts or pipes without approval. Reinforce all members damaged by such cutting or boring by means of specially formed and approved sheet metal or bar steel shapes, or remove and provide new, as approved. Provide as necessary for the proper completion of the work all framing members not indicated or specified. Spiking and nailing not indicated or specified otherwise shall be in accordance with the Nailing Schedule contained in ICC IBC; perform bolting in an approved manner. Spikes, nails, and bolts shall be drawn up tight. Use slate or steel shims when leveling joists, beams, and girders on masonry or concrete. Do not use shimming on wood or metal bearings. When joists, beams, and girders are placed on masonry or concrete, a wood base plate shall be positioned and leveled with grout. The joist, beam, or girder shall then be placed on the plate. When joists, beams, and girders are set into masonry or concrete, a pocket shall be formed into the wall. The joist, beam, or girder shall then be placed into the pocket and leveled with a steel shim.

3.1.1 Roof Framing or Rafters

Tops of supports or rafters shall form a true plane. Valley, ridge, and hip members shall be of depth equal to cut on rafters where practicable, but in no case less than depth of rafters and nominally 2 inches thick. Rafters shall have full and solid bearing on plates. Valleys, hips, and ridges shall be straight and true intersections of roof planes. Necessary crickets and watersheds shall be formed. Rafters shall be toe-nailed to ridge, valley, or hip members with at least three 8-penny nails. Rafters shall be braced to prevent movement until permanent bracing, decking or sheathing is installed. Hip and valley rafters shall be secured to wall plates by clip angles. Openings in roof shall be framed with headers and trimmers. Unless otherwise indicated, headers carrying more than two rafters and trimmers supporting headers carrying more than one rafter shall be double. Hip rafters longer than the available lumber shall be butt jointed and scabbed. Valley rafters longer than the available lumber shall be double, with pieces lapped not less than 4 feet and well spiked together. Trussed rafters shall be installed in accordance with TPI HIB. Engineered wood joists shall be installed in accordance with distributor's instructions.

3.1.2 Joists

Provide joists of the sizes and spacing indicated, accurately and in alignment, and of uniform width. Joists shall have full bearing on plates; provide laps over bearing only and spike. Where joists are of insufficient length to produce a 12 inch lap, butt joists over bearing and provide wood scabs 2 nominal inches thick by depth of joists by 24 inches long or metal straps 1/4 by 1 1/2 inch by not less than 18 inches long nailed to each joist with not less than four 10-penny nails, or approved sheet metal connectors installed in accordance with the manufacturer's recommendations. The minimum joist end bearing shall be 4 inches. For joists approved to be bored for the passage of pipes or conduits, bore through the neutral axis of the joist.

3.1.3 Bridging

Provide bridging for floor and ceiling joists and for roof rafters having slopes of less than 1/3. Locate bridging as indicated and as specified herein. Provide bridging for spans greater than 6 feet, but do not exceed 8 feet maximum spacing between rows of bridging. Install rows of bridging uniformly. Provide metal or wood cross-bridging, except where solid bridging is indicated. Do not nail the bottom end of cross-bridging until the subfloor has been laid.

3.1.4 Building Paper

Provide building paper where indicated. Lap edges 4 inches, and nail with one inch, zinc-coated roofing nails, spaced 12 inches o.c. and driven through tin discs.

3.1.5 Plywood Roof Sheathing

Install with the long dimension at right angles to supports. Stagger end joints and locate over the centerlines of supports. Allow 1/8 inch spacing at panel ends and 1/4 inch at panel edges. Nail panels with 8-penny common nails or 6-penny annular rings or screw-type nails spaced 6 inches o.c. at supported edges and 12 inches o.c. at intermediate bearings. Do not use staples in roof sheathing. Where the support spacing exceeds the maximum

span for an unsupported edge, provide adequate blocking, tongue-and-groove edges, or panel edge clips, in accordance with APA E30.

3.2 MISCELLANEOUS

3.2.1 Wood Roof Nailers, Edge Strips, Crickets, Curbs, and Cants

Provide sizes and configurations indicated or specified and anchored securely to continuous construction.

3.2.2 Wood Blocking

Provide proper sizes and shapes at proper locations for the installation and attachment of wood and other finish materials, fixtures, equipment, and items indicated or specified.

3.2.3 Temporary Closures

Provide with hinged doors and padlocks and install during construction at exterior doorways and other ground level openings that are not otherwise closed. Cover windows and other unprotected openings with polyethylene or other approved material, stretched on wood frames. Provide dustproof barrier partitions to isolate areas as directed.

3.2.4 Temporary Centering, Bracing, and Shoring

Provide for the support and protection of masonry work during construction as specified in Section 04200.

3.2.5 Bridging

Wood bridging shall have ends accurately bevel-cut to afford firm contact and shall be nailed at each end with two nails. Metal bridging shall be installed as recommended by the manufacturer. The lower ends of bridging shall be driven up tight and secured after subflooring or roof sheathing has been laid and partition framing installed.

3.2.6 Corner Bracing

Corner bracing shall be installed when required by type of sheathing used or when siding, other than panel siding, is applied directly to studs. Corner bracing shall be let into the exterior surfaces of the studs at an angle of approximately 45 degrees, shall extend completely over wall plates, and shall be secured at each bearing with two nails.

-- End of Section --

SECTION 06193

METAL PLATE CONNECTED WOOD TRUSSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manufacture, supply and erection of wood trusses for roof framing.

B. Anchorage, blocking, curbing, miscellaneous framing and bracing.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)

Softwood Lumber Standards

1.3 SYSTEM DESCRIPTION

A. Trusses shall be designed in accordance with these specifications. Where any applicable design feature is not specifically covered here in, design shall be in accordance with applicable provisions of the latest edition of TPI 1 "National Design Standard for Metal Plate Connected Wood Truss Construction", the "National Design Specifications for Wood Construction", and Local code jurisdictions.

B. Manufacturer shall furnish truss design drawings boaring seal and signature of a professional engineer licensed in Virginia, for approval.

C. Truss design drawings shall include as minimum information:

1. Span, slope and spacing of trusses;

2. Required bearing width.

3. Design loads as applicable.

4. Adjustments to lumber and metal plate connector design values for condition of use.

5. Reaction forces, their points of occurrence and direction.

6. Metal plate connector type, gage, size and location of plate at each joint, except where symmetrically located relative to the joint interface.

7. Lumber size, species and grade for each member.

8. Location of any permanent truss member bracing.

9. Calculated deflection ratio and/or maximum deflection for live and total load.

10. Maximum axial compression force in truss members; force may be shown on the truss design drawing or on supplemental documents.

11. Location of all joints

12. Connection requirements for:
a. truss to truss girder

b. truss ply-to-ply

c. field splices

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01300, Submittal Procedures.

SD-03 Product Data

Location(s) of product manufacture and of harvest/ extraction/ recovery of primary materials used in product. Forest Stewardship Council (FSC) certification for all sustainably harvested wood, including chain of custody number.

SD-02 Shop Drawings

See System Description Paragraph C for Requirements

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the following agencies:

1. Lumber Grading Agency: Certified by Softwood Lumber Standards.

B. Truss Design: See Systems Description, paragraph A.

D. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

E. Design trusses under direct supervision of a Professional Engineer experienced in design of this Work and licensed in the State of Virginia.

1.6 REGULATORY REQUIREMENTS

A. Conform to VAUSBC for loads, seismic zoning, other governing load criteria.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Section 01600 - Material and Equipment: Transport, handle, store, and protect products.

B. Handle and erect trusses in accordance with Commentary and Recommendations for "Handling, Installing and Bracing Metal Plate Connected wood trusses TPI HIB-91.

C. Store truss depth in vertical position resting on intermittent

bearing pads.

PART 2 PRODUCT

2.1 MATERIALS

A. Lumber Grading Rules: SPIB.

B. Give preference to lumber manufactured and harvested/ extracted/ recovered within a 500-mile radius of the Project Site. Give preference to sustainably harvested wood bearing the FSC certification.

C. Wood Members: Lumber shall be in accordance with published values of lumber rules writing agencies approved by board of reviews of American Lumber Standards Committee; Lumber shall be indentified by grade mark of a lumber inspection bureau or agency approved by that board, and shall be shown on the truss drawings; percent maximum and 7 percent minimum moisture content. Finger scarfing not permitted.

D. Adjustment of values for furation of load or conditions of use shall be in accordance with National Design Specifications for Wood Construction, NDS.

E. Metal Plate Connectors shall be manufactured by a WTCA member plate manufacturer and shall not be less than 0.036 inches in thickness(20 gage) and shall meet or exceed ASTM A653 Grade 33; galvanized coating shall meet or exceed ASTM A924, G60.

F. Truss Bridging: Type, size and spacing recommended by truss manufacturer.

2.2 ACCESSORIES

A. Wood Blocking, Support Members, Framing for Openings: In accordance with Section 06100.

B. Fasteners and Anchors:

1. Fasteners: Hot dipped galvanized steel.

2. Anchors: As indicated by the truss manafacturers shop drawings.

2.3 FABRICATION

A. Fabricate trusses to achieve structural requirements specified.

B. Provide top chord extensions as indicated.

C. Frame special sized openings in web framing as detailed.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that supports and openings are ready to receive trusses.

3.2 PREPARATION

A. Coordinate placement of bearing items.

3.3 ERECTION

A. Install trusses HIB-91 trusses in accordance with manufacturer's instructions and TPI BWT-76.

B. Set members level and plumb, in correct position.

C. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb, and in true alignment until completion of erection and installation of permanent bracing.

D. Do not field cut or alter structural members without approval of Architect/Engineer.

E. Place headers and supports to frame openings.

F. Frame openings between trusses with lumber in accordance with Section 06100.

G. Coordinate placement of sheathing with work of this section.

-- End of Section --

SECTION 06200

FINISH CARPENTRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.2.1	(1996; Errata 2003) Square and Hex Bolts and Screws Inch Series
ANSI B18.6.1	(1981; R 1997) Wood Screws (Inch Series)

ASME INTERNATIONAL (ASME)

ASME B18.2.2	(1987; R 1999) Square and Hex Nuts

ASTM INTERNATIONAL (ASTM)

ASTM A 687	(1993) High-Strength Nonheaded Steel Bolts and Studs
ASTM D 792	(2000) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM F 547	(2001) Nails for Use with Wood and Wood-Base Materials

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S. 4	(2000) Water-Repellent Preservative Non-Pressure Treatment for Millwork

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

PVC Trim

Manufacturer's printed data indicating the usage of recycled

products, and environmentally safe preservatives.

Location(s) of product manufacture and of harvest/ extraction/ recovery of primary materials used in product. MSDS of all field applied adhesives and sealants used within the building interior, highlighting VOC content.

SD-04 Samples

Fascias and Trim

Samples shall be of sufficient size to show patterns, color ranges, and types, as applicable, of the material proposed to be used.

SD-07 Certificates

Certificates of grade

Certificates of compliance

1.3 DETAIL DRAWINGS

The Contractor shall submit detail drawings showing fabricated items and special mill and woodwork items. Drawings shall indicate materials and details of construction, methods of fastening, erection, and installation.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver trim and millwork to job site in an undamaged condition. Stack materials to ensure ventilation and drainage. Protect against dampness before and after delivery. Store materials under cover in a well-ventilated enclosure and protect against extreme changes in temperature and humidity. Do not store products in building until wet trade materials are dry.

1.5 QUALITY ASSURANCE

1.5.1 Nonpressure-Treated Woodwork and Millwork

Mark, stamp, or label, indicating compliance with WDMA I.S. 4.

PART 2 PRODUCTS

2.1 CELLULAR PVC

2.1.1 Sizes and Patterns of Cellular PVC Products

Cellular PVC shall have a minimum of diversity 500kg/m3 in accordance with ASTM D 792, with a maximum flam spread index of 25 in accordance with ASTM E 84. Provide shaped lumber and millwork in the patterns indicated and standard patterns of the manufactuer. Size references, unless otherwise specified, are nominal lumber stock sizes, and actual sizes shall be finished lumber sizes. Provide products containing the maximum recycled content feasible.

2.1.2 Trim, Finish, and Frames

Provide profiles as indicated on drawings, with a maximum thickness of 1/2".

2.2 FASCIAS AND TRIM

2.2.1 Cellular PVC

Fascias and trim, including exterior door and window casing, shall be. Sizes and Cellular PVC & profiles shall be as indicated. Provide products containing the maximum recycled content feasible.

2.3 HARDWARE

Provide sizes, types, and spacings of manufactured building materials recommended by the product manufacturer except as otherwise indicated or specified.

2.3.1 Wood Screws

ANSI B18.6.1.

2.3.2 Bolts, Nuts, Lag Screws, and Studs

ANSI B18.2.1, ASME B18.2.2, and ASTM A 687.

2.3.3 Nails

Nails shall be the size and type best suited for the purpose and shall conform to ASTM F 547. Nails shall be hot-dip galvanized or aluminum when used on exterior work. For siding, length of nails shall be sufficient to extend 1-1/2 inches into supports, including wood sheathing over framing. Screws for use where nailing is impractical shall be size best suited for purpose.

PART 3 EXECUTION

3.1 FINISH WORK

Provide sizes, materials, and designs as indicated and as specified. Where practicable, shop assemble items of built-up millwork. Joints shall be tight. Miter trim and moldings at exterior angles and cope at interior angles and at returns. Material shall show no warp after installation. Install millwork and trim in maximum practical lengths. Fasten finish work to masonry surfaces with adhesive. fasten trim to wood framing with finish nails. Provide blind nailing where practicable. Set face nails for putty stopping.

3.1.1 Exterior Finish Work

Machine-sand exposed flat members and square edges. Machine-finish semi-exposed surfaces. Construct joints to exclude water. In addition to nailing, glue joints of built-up items as necessary for weather-resistant construction. Provide well distributed end joints in built-up members. Provide shoulder joints in flat work. Hold backs of wide-faced miters together with metal rings and waterproof glue. Fascias and other flat members, unless otherwise indicated, shall be 3/4 inch thick. Provide door and window trim in single lengths. Provide braced, blocked, and rigidly anchored cornices for support and protection of vertical joints. Install soffits in largest practical size. Joints of plywood shall occur over center lines of supports. Fasten soffits with stainless steel nails.

3.1.2 Interior Finish Work

After installation, sand exposed surfaces smooth. Provide window and door trim in single lengths.

3.1.3 Window Stools and Aprons

Provide stools with rabbet over window sill. Provide aprons with returns cut accurately to profile of member.

3.1.4 Bases

Flat member with a molded top. Fasten base to framing or to grounds. Base trim after finish flooring is in place.

3.2 FASCIAS AND EXTERIOR TRIM

Exposed surfaces and square edges shall be machine sanded, caulked, and constructed to exclude water. Joints of built-up items, in addition to nailing, shall be glued as necessary for weather-resistant construction. End joints in built-up members shall be well distributed. Joints in flat work shall be shouldered. Backs of wide-faced miters shall be held together with metal rings and glue. Fascias and other flat members shall be in maximum practicable lengths. Cornices shall be braced, blocked, and rigidly anchored for support and protection of vertical joints.

3.3 MOLDING AND INTERIOR TRIM

Molding and interior trim shall be installed straight, plumb, level and with closely fitted joints. Exposed surfaces shall be machine sanded at the mill. Molded work shall be coped at returns and interior angles and mitered at external corners. Intersections of flatwork shall be shouldered to ease any inherent changes in plane. Window and door trim shall be provided in single lengths. Blind nailing shall be used to the extent practicable, and face nailing shall be set and stopped with a nonstaining putty to match the finish applied. Screws shall be used for attachment to metal; setting and stopping of screws shall be of the same quality as required where nails are used.

-- End of Section --

SECTION 06410

LAMINATE CLAD ARCHITECTURAL CASEWORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A161.2	(1998) Decorative Laminate Countertops, Performance Standards for Fabricated High Pressure

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual Stds	(2003) AWI Quality Standards

ASTM INTERNATIONAL (ASTM)

ASTM F 547	(2001) Nails for Use with Wood and Wood-Base Materials

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.9	(2003) Cabinet Hardware

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(2000) High-Pressure Decorative Laminates

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S. 1-A	(1997) Architectural Wood Flush Doors

1.2 GENERAL DESCRIPTION

Work in this section includes laminate clad custom casework as shown on the drawings and as described in this specification. This Section includes high-pressure laminate surfacing and cabinet hardware.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings
Installation

Shop drawings showing all fabricated casework items in plan

view, elevations and cross-sections to accurately indicate materials used, details of construction, dimensions, methods of fastening and erection, and installation methods proposed. Shop drawing casework items shall be clearly cross-referenced to casework items located on the project drawings. Shop drawings shall include a color schedule of all casework items to include all countertop, exposed, and semi-exposed cabinet finishes to include finish material manufacturer, pattern, and color.

SD-03

Cabinet Hardware

Catalog data for each cabinet hardware item specified.

Location(s) of product manufacture and of harvest/ extraction/ recovery of primary materials used in product.
MSDS of all adhesives and laminate glues shop-applied and field-applied within the building interior, highlighting VOC content. Plywood manufacturer's product data for each plywood product used indicating that bonding agent used contains no urea formaldehyde. Forest Stewardship Council (FSC) certification for all sustainably harvested wood, including chain of custody number.

SD-04 Samples

Plastic Laminates

Two samples of each plastic laminate pattern and color. Samples shall be a minimum of 5 by 7 inches in size.

1.4 QUALITY ASSURANCE

Unless otherwise noted on the drawings, all materials, construction methods, and fabrication shall conform to and comply with the custom grade quality standards as outlined in AWI Qual Stds, Section 400G and Section 400B for laminate clad cabinets. These standards shall apply in lieu of omissions or specific requirements in this specification. Contractors and their personnel engaged in the work shall be able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified. Contractor must demonstrate knowledge and understanding of AWI Qual Stds requirements for the quality grade indicated.

1.5 DELIVERY AND STORAGE

Casework shall be delivered fully assembled. All units shall be delivered to the site in undamaged condition, stored off the ground in fully enclosed areas, and protected from damage. The storage area shall be well ventilated and not subject to extreme changes in temperature or humidity.

1.6 SEQUENCING AND SCHEDULING

Work shall be coordinated with other trades. Units shall not be installed in any room or space until painting, and ceiling installation, and flooring are complete within the room where the units are located.

1.7 PROJECT/SITE CONDITIONS

Field measurements shall be verified as indicated in the shop drawings

before fabrication.

PART 2 PRODUCTS

2.1 WOOD MATERIALS

2.1.1 Lumber

All framing lumber shall be kiln-dried Grade III to dimensions as shown on the drawings. Frame front, where indicated on the drawings, shall be nominal 3/4 inch hardwood.

Give preference to products manufactured and of primary raw materials harvested/ extracted/ recovered within a 500-mile radius of the Project Site. Give preference to sustainably harvested wood bearing the FSC certification.

2.1.2 Panel Products

2.1.2.1 Plywood

All plywood panels used for framing purposes shall be veneer core hardwood plywood, AWI Qual Stds Grade AA. Nominal thickness of plywood panels shall be as indicated in this specification and on the drawings.

Plywood shall be manufactured with a bonding agent containing no urea formaldehyde. Give preference to products manufactured and of primary raw materials harvested/ extracted/ recovered within a 500-mile radius of the Project Site. Give preference to sustainably harvested wood bearing the FSC certification.

2.2 SOLID POLYMER MATERIAL

Solid surfacing casework components shall conform to the requirements of Section 06650 SOLID POLYMER (SOLID SURFACING) FABRICATIONS.

2.3 HIGH PRESSURE DECORATIVE LAMINATE (HPDL)

All plastic laminates shall meet the requirements of NEMA LD 3 and ANSI A161.2 for high-pressure decorative laminates. Design, colors, surface finish and texture, and locations shall be as indicated on the drawings. Plastic laminate types and nominal minimum thicknesses for casework components shall be as indicated in the following paragraphs.

2.3.1 Horizontal General Purpose Standard (HGS) Grade

Horizontal general purpose standard grade plastic laminate shall be 0.048 inches (plus or minus 0.005 inches) in thickness. This laminate grade is intended for horizontal surfaces where postforming is not required.

2.3.2 Vertical General Purpose Standard (VGS) Grade

Vertical general purpose standard grade plastic laminate shall be 0.028 inches (plus or minus 0.004 inches) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of casework components where postforming is not required.

2.3.3 Backing Sheet (BK) Grade

Undecorated backing sheet grade laminate is formulated specifically to be used on the backside of plastic laminated panel substrates to enhance dimensional stability of the substrate. Backing sheet thickness shall be 0.020 inches. Backing sheets shall be provided for all laminated casework components where plastic laminate finish is applied to only one surface of the component substrate.

2.4 THERMOSET DECORATIVE OVERLAYS (MELAMINE)

Thermoset decorative overlays (melamine panels) shall be used for casework cabinet interior surfaces.

2.5 EDGE BANDING

Edge banding for casework doors and drawer fronts shall be PVC vinyl and shall be 0.020 inch thick. Material width shall be 15/16 inches. Color and pattern shall match exposed door and drawer front laminate pattern and color.

2.6 CABINET HARDWARE

All hardware shall conform to BHMA A156.9, unless otherwise noted, and shall consist of the following components:

a. Door Hinges: 120º frameless, concealed type, BHMA No. B01602.

b. Cabinet Locks: Cam type, BHMA No. E07291 keyed alike.

c. Adjustable Shelf Support System:

Recessed (mortised) metal standards, BHMA No. BO4071, finish: White. Support clips for the standards shall be closed type, BHMA No. B04081, finish: White

2.7 FASTENERS

Nails, screws, and other suitable fasteners shall be the size and type best suited for the purpose and shall conform to ASTM F 547 where applicable.

2.8 ADHESIVES, CAULKS, AND SEALANTS

2.8.1 Adhesives

Adhesives shall be of a formula and type recommended by AWI. Adhesives shall be selected for their ability to provide a durable, permanent bond and shall take into consideration such factors as materials to be bonded, expansion and contraction, bond strength, fire rating, and moisture resistance. Adhesives shall meet local regulations regarding VOC emissions and off-gassing.

Adhesives shall contain no urea formaldehyde. Field applied adhesives shall have a VOC content not to exceed 30 g/l. General purpose mist spray aerosol adhesives shall contain not more than 65% VOCs by weight. General purpose web spray aerosol adhesives shall contain not more than 55% VOCs by weight. Special purpose aerosol adhesives (all types) shall contain not more than 70% VOCs by weight.

2.8.1.1 Wood Joinery

Adhesives used to bond wood members shall be a Type II for interior use non-urea-formaldehyde resin formula. Adhesives shall withstand a bond test as described in WDMA I.S. 1-A.

2.8.1.2 Laminate Adhesive

Adhesive used to join high-pressure decorative laminate to wood shall be a water-based contact adhesive. PVC edgebanding shall be adhered using a polymer-based hot melt glue.

2.8.2 Caulk

Caulk used to fill voids and joints between laminated components and between laminated components and adjacent surfaces shall be clear, 100 percent silicone.

2.8.3 Sealant

Sealant shall be of a type and composition recommended by the substrate manufacturer to provide a moisture barrier at sink cutouts and all other locations where unfinished substrate edges may be subjected to moisture. Caulk shall have a VOC content not to exceed 250 g/l.

2.9 FABRICATION

Fabrication and assembly of components shall be accomplished at the shop site to the maximum extent possible. Construction and fabrication of cabinets and their components shall meet or exceed the requirements for AWI custom grade unless otherwise indicated in this specification. Cabinet style, in accordance with AWI Qual Stds, Section 400-G descriptions, shall be flush overlay. Sealants shall have a VOC content not to exceed 250 g/l.

2.9.1 Base and Wall Cabinet Case Body

2.9.1.1 Cabinet Components

Frame members shall be glued-together, kiln-dried hardwood lumber. Top corners, bottom corners, and cabinet bottoms shall be braced with hardwood blocks. Cabinet components shall be constructed from the following materials and thicknesses:

a. Body Members (Ends, Divisions, Bottoms, and Tops): 3/4 inch veneer core plywood panel product.

b. Face Frames and Rails: 3/4 inch hardwood lumber.

c. Shelving: 3/4 inch veneer core plywood panel product.

d. Cabinet Backs: 1/4 inch medium density fiberboard 9MDF panel product. Medium density fiberboard shall be manufactured with a bonding agent containing no urea formaldehyde

e. Door Fronts: 3/4-inch veneer core plywood panel product.

2.9.1.2 Joinery Method for Case Body Members

a. Tops, Exposed Ends, and Bottoms.

1) Stop dado, glued under pressure, and either nailed, stapled or screwed (fasteners will not be visible on exposed parts).

2) Spline or biscuit, glued under pressure.

b. Exposed End Corner and Face Frame Attachment.

1) For mitered joint: lock miter or spline or biscuit, glued under pressure (no visible fasteners).

2) For non-mitered joint (90 degree): butt joint glued under pressure (no visible fasteners).

3) Butt joint, glued and nailed.

c. Cabinet Backs (Floor Standing Cabinets).

1) Side bound, captured in grooves; glued and fastened to top and bottom.

d. Wall Anchor Strips shall be required for all cabinets with backs less than 1/2 inch thick. Strips shall consist of minimum 1/2 inch thick lumber, minimum 2-1/2 inches width; securely attached to wall side of cabinet back - top and bottom for wall hung cabinets, top only for floor standing cabinets.

2.9.2 Cabinet Floor Base

Floor cabinets shall be mounted on a base constructed of nominal 2 inch thick lumber. Base assembly components shall be treated lumber. Finished height for each cabinet base shall be as indicated on the drawings. Bottom edge of the cabinet door shall be flush with top of base.

2.9.3 Cabinet Doors

Doors shall be fabricated from 3/4 inch veneer core plywood. All door edges shall be surfaced with PVC edgebanding, color and pattern to match exterior face laminate.

2.9.4 Shelving

2.9.4.1 General Requirements

Shelving shall be fabricated from 3/4 inch veneer core plywood. All shelving top and bottom surfaces shall be finished with HPDL plastic laminate. Shelf edges shall be finished in a PVC edgebanding.

2.9.4.2 Shelf Support System

The shelf support system shall be:

Recessed (mortised) metal shelf standards. Standards shall be mortised flush with the finishes surface of the cabinet interior side walls, two per side. Standards shall be positioned and spaced on the side walls to provide a stable shelf surface that eliminates tipping when shelf front is weighted. Standards shall be installed and adjusted vertically to provide a level, stable shelf surface when clips are in place.

2.9.5 Laminate Application

Laminate application to substrates shall follow the recommended procedures and instructions of the laminate manufacturer and NEMA LD 3, using tools and devices specifically designed for laminate fabrication and application. Provide a balanced backer sheet (Grade BK) wherever only one surface of the component substrate requires a plastic laminate finish. Apply required grade of laminate in full uninterrupted sheets consistent with manufactured sizes using one piece for full length only, using adhesives specified herein or as recommended by the manufacturer. Fit corners and joints hairline. All laminate edges shall be machined flush, filed, sanded, or buffed to remove machine marks and eased (sharp corners removed). Clean up at easing shall be such that no overlap of the member eased is visible. Fabrication shall conform to ANSI A161.2. Laminate types and grades for component surfaces shall be as follows unless otherwise indicated on the drawings:

a. Base/Wall Cabinet Case Body.

1) Exterior (exposed) surfaces to include exposed and semi-exposed face frame surfaces: HPDL Grade VGS.

2) Interior (semi-exposed) surfaces to include interior back wall, bottom, and side walls: Thermoset Decorative Overlay (melamine).

b. Adjustable Shelving.

1) Top and bottom surfaces: HPDL Grade HGS.

2) All edges: PVC edgebanding.

c. Doors.

1) Exterior (exposed) and interior (semi-exposed) faces: HPDL Grade VGS.

2) Edges: PVC edgebanding.

d. Tolerances

Flushness, flatness, and joint tolerances of laminated surfaces shall meet the AWI Qual Stds custom grade requirements.

2.9.6 Finishing

2.9.6.1 Filling

No fasteners shall be exposed on laminated surfaces. All nails, screws, and other fasteners in non-laminated cabinet components shall be countersunk and the holes filled with wood filler consistent in color with the wood species.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall comply with applicable requirements for AWI Qual Stds custom quality standards. Countertops and fabricated assemblies shall be

installed level, plumb, and true to line, in locations shown on the drawings. Cabinets and other laminate clad casework assemblies shall be attached and anchored securely to the floor and walls with mechanical fasteners that are appropriate for the wall and floor construction.

3.1.1 Anchoring Systems

3.1.1.1 Floor

Base cabinets shall utilize a floor anchoring system. Anchoring and mechanical fasteners shall not be visible from the finished side of the casework assembly. Cabinet assemblies shall be attached to anchored bases without visible fasteners. Where assembly abutts a wall surface, anchoring shall include a minimum 1/2 inch thick lumber or panel product hanging strip, minimum 2-1/2 inch width; securely attached to the top of the wall side of the cabinet back.

3.1.2 Hardware

Casework hardware shall be installed in types and locations as indicated on the drawings.

3.1.3 Doors

The fitting of doors shall be accomplished within target fitting tolerances for gaps and flushness in accordance with AWI Qual Stds custom grade requirements.

-- End of Section --

SECTION 06650

SOLID POLYMER (SOLID SURFACING) FABRICATIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.1	(1999) Installation of Ceramic Tile; including A108.1A-C, 108.4-.13, 118.1-.10, A136.1
ANSI Z124.3	(1995) Plastic Lavatories
ANSI Z124.6	(1997) Plastic Sinks

1.2 GENERAL DESCRIPTION

Work in this section includes solid polymer (solid surfacing) fabrication as shown on the drawings and as described in this specification. Do not change source of supply for materials after work has started. Variation in component size and location of openings to be plus or minus 1/8 inch.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

Detail Drawings indicating locations, dimensions, component sizes, fabrication and joint details, attachment provisions, installation details, and coordination requirements with adjacent work.

SD-03 Product Data

Solid polymer material
Qualifications
Fabrications

Product data indicating product description, fabrication information, and compliance with specified performance requirements for solid polymer, joint adhesive, and sealants.

MSDS of all field applied adhesives and sealants used within the building interior, highlighting VOC content. MSDS of all shop-applied and field-applied laminate glues indicating that bonding agent used contains no urea formaldehyde.

SD-04 Samples

Material

A minimum 4 by 4 inch sample of each color and pattern for approval. Samples shall indicate full range of color and pattern variation. Approved samples shall be retained as a standard for this work.

SD-10 Operation and Maintenance Data

Clean-up

Maintenance data indicating manufacturer's care, repair and cleaning instructions. Maintenance video shall be provided,if available. Maintenance kit for matte finishes shall be submitted.

1.4 DELIVERY, STORAGE AND HANDLING

Materials shall not be delivered to project site until areas are ready for installation. Components and materials shall be delivered to the site undamaged, in containers clearly marked and labeled with manufacturer's name. Materials shall be stored indoors and adequate precautions taken to prevent damage to finished surfaces. Protective coverings shall be provided to prevent physical damage or staining following installation, for duration of project.

1.5 WARRANTY

Manufacturer's warranty of ten years against defects in materials, excluding damages caused by physical or chemical abuse or excessive heat, shall be provided. Warranty shall provide for material and labor for replacement or repair of defective material for a period of ten years after component installation.

1.6 QUALIFICATIONS

To insure warranty coverage, solid polymer fabricators shall be certified to fabricate by the solid polymer material manufacturer being utilized. All fabrications shall be marked with the fabricator's certification label affixed in an inconspicuous location. Fabricators shall have a minimum of 5 years of experience working with solid polymer materials.

PART 2 PRODUCTS

2.1 MATERIAL

Solid polymer material shall be a homogeneous filled solid polymer; not coated, laminated or of a composite construction; meeting ANSI Z124.3 and ANSI Z124.6 requirements. Superficial damage to a depth of 0.01 inch shall be repairable by sanding or polishing. Material thickness shall be as indicated on the drawings.

2.1.1 Acceptable Manufacturers

1. Avonite Studio Collection
2. Formica Signatures Collection
3. Wilsonart Gibraltar "Rich" Collection

2.1.2 Material Patterns and Colors

Patterns and colors for all solid polymer components and fabrications shall be those indicated on the project drawings. Pattern and color shall occur, and shall be consistent in appearance, throughout the entire depth (thickness) of the solid polymer material.

2.1.3 Surface Finish

Exposed finished surfaces and edges shall receive a uniform appearance. Exposed surface finish shall be semigloss; gloss rating of 25-50.

2.2 ACCESSORY PRODUCTS

Accessory products, as specified below, shall be manufactured by the solid polymer manufacturer or shall be products approved by the solid polymer manufacturer for use with the solid polymer materials being specified.

2.2.1 Seam Adhesive

Seam adhesive shall be a two-part adhesive kit to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between solid polymer materials and components to create a monolithic appearance of the fabrication. Adhesive shall be approved by the solid polymer manufacturer. Adhesive shall be color-matched to the surfaces being bonded where solid-colored, solid polymer materials are being bonded together. The seam adhesive shall be clear or color matched where particulate patterned, solid polymer materials are being bonded together.

Adhesives shall have a VOC content not to exceed 250 g/l.

2.2.2 Panel Adhesive

Panel adhesive shall be neoprene based panel adhesive meeting ANSI A108.1, Underwriter's Laboratories (UL) listed. This adhesive shall be used to bond solid polymer components to adjacent and underlying substrates.

Panel adhesive shall have a VOC content not to exceed 50 g/l.

2.2.3 Silicone Sealant

Sealant shall be a mildew-resistant, FDA and UL listed silicone sealant or caulk in a clear formulation. The silicone sealant shall be approved for use by the solid polymer manufacturer. Sealant shall be used to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures.

Sealant shall have a VOC content no to exceed 250 g/l.

2.3 FABRICATIONS

Components shall be factory or shop fabricated to sizes and shapes indicated, to the greatest extent practicable, in accordance with approved Shop Drawings and manufacturer's requirements. Factory cutouts shall be provided where indicated on the drawings. Contours and radii shall be routed to template, with edges smooth. Defective and inaccurate work will be rejected.

2.3.1 Joints and Seams

Joints and seams shall be formed between solid polymer components using manufacturer's approved seam adhesive. Joints shall be inconspicuous in appearance and without voids to create a monolithic appearance.

2.3.2 Edge Finishing

Rout and finish component edges to a smooth, uniform appearance and finish. Edge shapes and treatments, including any inserts, shall be as detailed on the drawings. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.

2.3.3 Counter and Vanity Top Splashes

Backsplashes and end splashes shall be fabricated from 1/2 inch thick solid surfacing material and shall be provided to dimensions and shapes as indicated on the drawings. Backsplashes and end splashes shall be provided for all counter tops. Backsplashes shall be shop fabricated and be loose, to be field attached.

2.3.3.1 End Splashes

End splashes shall be provided loose for installation at the jobsite after horizontal surfaces to which they are to be attached have been installed.

2.3.4 Counter and Vanity Tops

All solid surfacing, solid polymer counter top components shall be fabricated from 1/2 inch thick material. Edge details, dimensions, locations, and quantities shall be as indicated on the Drawings. Counter tops shall be complete with loose backsplash and endsplashes at all locations. Attach 2 inch wide reinforcing strip of polymer material under each horizontal counter top seam.

2.3.4.1 Counter Top Cutouts

Cutouts shall be made to template. Joints and cutouts shall be reinforced as recommended by the solid polymer manufacturer.

PART 3 EXECUTION

3.1 COORDINATION

In most instances, installation of solid polymer fabricated components and assemblies will require strong, correctly located structural support provided by other trades. To provide a stable, sound, secure installation, close coordination is required between the solid polymer fabricator/installer and other trades to insure that necessary cabinet counter top structural support, proper clearances, and other supporting components are provided for the installation of countertops To the degree and extent recommended by the solid polymer manufacturer. Contractor shall appropriate staging areas for solid polymer fabrications.

3.2 INSTALLATION

3.2.1 Components

All components and fabricated units shall be installed plumb, level, and rigid. Field joints between solid polymer components to provide a monolithic appearance shall be made using solid polymer manufacturer's approved seam adhesives, with joints inconspicuous in the finished work.

3.2.1.1 Loose Counter Top Splashes

Loose splashes shall be mounted in locations as noted on the drawings. Loose splashes shall be adhered to the counter top with a color matched silicone sealant when the solid polymer components are solid colors. Adhesion of particulate patterned solid polymer splashes to counter tops shall utilize a clear silicone sealant.

3.3 CLEAN-UP

Components shall be cleaned after installation and covered to protect against damage during completion of the remaining project items. Components damaged after installation by other trades will be repaired or replaced at the General Contractor's cost. Component supplier will provide a repair/replace cost estimate to the General Contractor who shall approve estimate before repairs are made. The Contractor shall submit maintenance data as specified in the Submittals paragraph, under SD-10.

-- End of Section --

SECTION 07112

BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 1187	(1997; R 2002e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM D 1227	(1995; R 2000) Emulsified Asphalt Used as a Protective Coating for Roofing
ASTM D 4263	(1983; R 1999) Indicating Moisture in Concrete by the Plastic Sheet Method

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-07 Certificates

Materials

1.3 DELIVERY AND STORAGE

Deliver materials in sealed containers bearing manufacturer's original labels. Labels shall include date of manufacture, contents of each container, performance standards that apply to the contents and recommended shelf life.

PART 2 PRODUCTS

2.1 EMULSION-BASED ASPHALT DAMPPROOFING

2.1.1 Fibrated Emulsion-Based Asphalt

Fibrated emulsion-based asphalt dampproofing shall be cold-applied type conforming to ASTM D 1227 Type IV, asbestos-free, manufactured of refined asphalt, emulsifiers and selected clay, fibrated with mineral fibers. For spray or brush application, emulsion shall contain a minimum of 59 percent solids by weight, 56 percent solids by volume. For trowel application, emulsion shall contain a minimum of 58 percent solids by weight, 55 percent solids by volume.

2.1.2 Non-Fibrated Emulsion-Based Asphalt

Non-fibrated emulsion-based asphalt dampproofing shall be cold-applied type conforming to ASTM D 1187 Type II or ASTM D 1227 Type III, manufactured of

refined asphalt, emulsifiers and selected clay. Asphalt shall contain a minimum 58 percent solids by weight, 55 percent solids by volume.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean masonry surfaces to receive dampproofing of foreign matter and loose particles. Apply dampproofing to clean dry surfaces. Moisture test in accordance with ASTM D 4263. If test indicates moisture, allow a minimum of 7 additional days after test completion for curing. If moisture still exists, redo test until substrate is dry.

3.2 Protection of Surrounding Areas

Before starting the dampproofing work, the surrounding areas and surfaces shall be protected from spillage and migration of dampproofing material onto other work.

Coordinate with requirements of Division 1 Section "Construction Indoor Air Quality Management."

3.3 APPLICATION

Apply dampproofing after priming coat is dry, but prior to any deterioration of primed surface, and when ambient temperature is above 40 degrees F.

3.3.1 Surface Priming

Apply primer when ambient temperature is above 40 degrees F and at rate of approximately one gallon per 100 square feet, fully covering entire surface to be dampproofed.

3.3.2 Cold-Application Method

3.3.2.1 Emulsion-Based Asphalt

Emulsion-based asphalt dampproofing work shall not be performed in temperatures below 40 degrees F. Emulsions shall have a smooth and uniform consistency at time of application. Dampproofing materials shall be applied in accordance with manufacturer's published instructions to produce a smooth uniform dry film of not less than 12 mils thick without voids or defects. Dull or porous spots shall be recoated. Dampproofing materials shall seal tightly around pipes and other items projecting through dampproofing. Rates of application shall be as follows:

a. Primer: 1/2 gallon per 100 square feet, cold-applied.

b. Fibrated Dampproofing: 2 gallons per 100 square feet, cold-applied with spray, brush or trowel.

c. Non-fibrated Dampproofing: 2 gallons per 100 square feet, cold-applied with spray, brush or trowel.

-- End of Section --

SECTION 07212

MINERAL FIBER BLANKET INSULATION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 665	(2001e1) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 930	(1999) Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM E 136	(1999eo1) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211	(2003) Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
NFPA 70	(2002) National Electrical Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.134	Respiratory Protection

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Blanket insulation

Accessories

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials to site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type,

grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.3.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

1.4 SAFETY PRECAUTIONS

1.4.1 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

1.4.2 Smoking

Do not smoke during installation of blanket thermal insulation.

1.4.3 Other Safety Concerns

Consider other safety concerns and measures as outlined in ASTM C 930.

PART 2 PRODUCTS

2.1 BLANKET INSULATION

ASTM C 665, Type I, blankets without membrane coverings; Class A, unfaced surface with a flame spread of 25 or less when tested in accordance with ASTM E 84.

2.1.1 Thermal Resistance Value (R-VALUE)

As indicated

2.1.2 Recycled Materials

Provide Thermal Insulation containing recycled materials to the extent practicable, provided the material meets all other requirements of this section. The minimum required recycled materials content by weight are:

Rock Wool: 75 percent slag
Fiberglass: 20 to 25 percent glass cullet

2.1.3 Prohibited Materials

Do not provide asbestos-containing materials.

2.2 BLOCKING

Wood, metal, unfaced mineral fiber blankets in accordance with ASTM C 665, Type I, or other approved materials. Use only non-combustible materials meeting the requirements of ASTM E 136 for blocking around chimneys and

heat producing devices.

2.3 ACCESSORIES

2.3.1 Adhesive

As recommended by the insulation manufacturer.

2.3.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

2.3.3 Wire Mesh

Corrosion resistant and as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, ensure that areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapor retarders. If moisture or other conditions are found that do not allow the workmanlike installation of the insulation, do not proceed but notify Architect of such conditions.

3.2 PREPARATION

3.2.1 Blocking at Attic Vents

Prior to installation of insulation, install permanent blocking to prevent insulation from slipping over, clogging, or restricting air flow through soffit vents at eaves.

3.2.2 Blocking Around Heat Producing Devices

Install non-combustible blocking around heat producing devices to provide the following clearances:

a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless these are certified by the manufacturer for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by NFPA 70 and, if insulation is to be placed above fixture or device, 24 inches above fixture.

b. Masonry chimneys or masonry enclosing a flue: 2 inches from outside face of masonry. Masonry chimneys for medium and high heat operating appliances: Minimum clearances required by NFPA 211.

c. Vents and vent connectors used for venting the products of combustion, flues, and chimneys other than masonry chimneys: Minimum clearances as required by NFPA 211.

Blocking around flues and chimneys is not required when insulation blanket, including any attached vapor retarder, passed ASTM E 136, in addition to meeting all other requirements stipulated in Part 2. Blocking is also not required if the chimneys are certified by the manufacturer for use in contact with insulating materials.

3.3 INSTALLATION

3.3.1 Insulation

Install and handle insulation in accordance with manufacturer's instructions. Keep material dry and free of extraneous materials. Ensure personal protective clothing and respiratory equipment is used as required. Observe safe work practices.

3.3.1.1 Electrical wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

3.3.1.2 Continuity of Insulation

Install blanket insulation to butt tightly against adjoining blankets and to studs, rafters, joists, sill plates, headers and any obstructions. Where insulation required is thicker than depth of joist, provide full width blankets to cover across top of joists. Provide continuity and integrity of insulation at corners, wall to ceiling joints, roof, and floor. Avoid creating thermal bridges.

3.3.1.3 Installation at Bridging and Cross Bracing

Insulate at bridging and cross bracing by splitting blanket vertically at center and packing one half into each opening. Butt insulation at bridging and cross bracing; fill in bridged area with loose or scrap insulation.

3.3.1.4 Insulation without Affixed Vapor Retarder

Provide snug friction fit to hold insulation in place. Stuff pieces of insulation into cracks between trusses, joists, studs and other framing, such as at attic access doors, door and window heads, jambs, and sills, band joists, and headers.

3.3.1.5 Sizing of Blankets

Provide only full width blankets when insulating between trusses, joists, or studs. Size width of blankets for a snug fit where trusses, joists or studs are irregularly spaced.

3.3.1.6 Special Requirements for Ceilings

Place insulation under electrical wiring occurring across joists. Pack insulation into narrowly spaced framing. Do not block flow of air through soffit vents.

3.3.1.7 Special Requirements

Hold insulation in place with corrosion resistant wire mesh or wire lacing.

-- End of Section --

SECTION 07213

NATURAL COTTON THERMAL BLANKET INSULATION

PART 1 GENERAL

1.1 REFERENCES

ASTM INTERNATIONAL (ASTM)

ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM C 518	(2004) Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 739-9.0	Corrosiveness of Cellulosic Fiber Insulation
ASTM C 739-11.0	Fungi Resistance of Cellulosic Fiber Insulation
ASTM C 739-12	Moisture Absorption of Cellulosic Fiber Insulation
ASTM C 739-13.00	Odor Emission of Fiber Insulation

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's printed product data and specifications.

B. Samples: Submit manufacturer's sample, minimum 6 inches square.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying material name and manufacturer.

B. Storage: Store materials in a clean, dry area in accordance with manufacturer's instructions.

C. Handling: Protect materials during handling and installation to prevent damage.

PART 2 PRODUCTS

2.1 MATERIALS

A. Natural Cotton Fiber Insulation: Unfaced batts made from post-industrial natural cotton fibers that have been thermally bonded.

B. R-value: = R-38 (ASTM C 518)

C. Fire Rating: Flame Spread - 5(Class A), Smoke Developed - 32(Class A) (ASTM E 84)

D. Mold/Mildew/Fungi Resistance: Pass=No Growth (ASTM C 739-11.0)

E. Corrosion Resistance: Pass (ASTM C 739-9.0)

F. Odor Emission: Pass (ASTM C 739-13.00)

G. Moisture Absorption: Pass-Less that 15 percent (ASTM C 739-12)

H. Retardant used also acts as excellent pest inhibitor.

I. Environmentally safe, sustainable, non-allergenic, non-hazardous, non-formaldehyde, non-itch insulation product.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify on site conditions.

B. Verify insulation layout and dimensions

C. Ensure areas are ready for insulation and accurately match accepted project drawings.

3.2 PREPARATION

A. Remove batts from packaging and shake to activate binding fibers. Batts should be given 5-10 minutes to begin rebound activity.

3.3 INSTALLTATION

A. Install insulation in accordance with manufacturer's instructions at locations indicated on the drawings.

B. Cut or tear insulation to fit snugly around electrical wall outlets and other cutouts.

C. Replace damaged materials as directed by Architect.

3.4 PROTECTION

Protect insulation from damage during construction

-- End of Section --

SECTION 07310

SYNTHETIC SLATE ROOFING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B 370	(2003) Copper Sheet and Strip for Building Construction
ASTM D 146	(2004) Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing
ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 412	(1998a; R 2002e1) Vulcanized Rubber and Thermoplastic Elastomers - Tension

NATIONAL ROOFING ContractorRS ASSOCIATION (NRCA)

NRCA 0405	(2001; R 2003, 5th Ed) Roofing and Waterproofing Manual

SHEET METAL AND AIR CONDITIONING ContractorRS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual	(2003, 6th Ed) Architectural Sheet Metal Manual

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings

Drawings showing flashing details.

SD-03 Product Data

Synthetic Slate Shingles - Location(s) of product manufacture and of harvest/ extraction/ recovery of primary materials used in product. Designation of the percentages of post-consumer and pre-consumer recycled-content in roofing materials.

SD-04 Samples

Synthetic Slate
Accessories for Slate Roofs

Three representative shingles to show color range.

SD-07 Certificates

Materials

Certificates of compliance attesting that the materials meet specification requirements.

1.3 QUALIFICATIONS

The Contractor shall provide qualified workers, trained and experienced in installing synthetic slate roofing systems of this configuration; and shall submit documentation of 5 consecutive years of work of this type. The Contractor shall be familiar with and shall perform work in accordance with SMACNA Arch. Manual and NRCA 0405. Where required for manufacturer's warranty, installer shall be factory-authorized installer of the roofing product.

1.4 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered in manufacturer's unopened bundles and containers with the manufacturer's brand and name marked clearly thereon. Shingles shall be stored in accordance with manufacturer's printed instructions. Roll goods shall be stored on end in an upright position. Immediately before laying, roofing materials shall be stored for 24 hours in an area maintained at a temperature between 45 degrees F and 80 degrees.

1.5 PROJECT/SITE CONDITIONS

1.5.1 Environmental Requirements

Roofing work shall proceed when existing and forecasted weather conditions permit work to be performed in accordance with manufacturer's recommendations and warranty requirements.

1.5.2 Drawings

The Contactor shall submit drawings as specified in the Submittals paragraph, under SD-02.

1.6 WARRANTY

The completed installation shall be inspected and approved by the roofing manufacturer's technical representative. A warranty shall be furnished against defects in material and workmanship of synthetic slate roof assembly, including related metal flashing for a period of 10 years from date of final acceptance of the work.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Synthetic Slate

Synthetic slate shall a class A material consisting of 100 percent recycled rubber and plastic compond, 12" wide by 18" long with a nominal thickness of 1/4. Weight shall be 300-325 lb/square based on 6" exposure.

Provide products manufactured and of primary raw materials harvested/ extracted/ recovered within a 500-mile radius of the Project Site. Provide products containing a minimum 90% pre-consumer recycled content.

2.1.1.1 Colors

Color shall be as indicated on the drawings.

2.1.2 Underlayment Membrane

An underlayment membrane shall be furnished on all surfaces to be covered with slate. Membrane shall consist of asphalt-saturated felt or high strength composite self-adhering membrane as directed.

2.1.2.1 Roofing Felt

Roofing felt shall be asphalt-saturated rag felt, Type II, No. 30 asphalt felt in accordance with ASTM D 226.

2.1.2.2 Elastomeric Membrane Underlayment

Membrane shall be a cold applied composite self-adhering membrane of not less than 0.004 inch high strength polyethylene film with slip resistant embossing, coated on one side with a thick layer of adhesive-consistency rubberized asphalt, interwound with a disposable silicone coated release sheet. The tensile strength and elongation values shall be not less than 250 psi when tested in accordance with ASTM D 412 and pliability shall be unaffected when tested in accordance with ASTM D 146.

2.1.2.3 Elastomeric Membrane Accessories

Two component urethane, mastic and primer shall be as approved by the membrane manufacturer. Flashing, expansion joint covers, temporary UV protection and corner fillets shall be as recommended by the membrane manufacturer.

2.1.3 Nails

Nails shall be manufacturer's recommended stainless steel roofing nails with 3/8 inchs dia head, 1 1/2 inches long. Minimum nails shall be of sufficient length to adequately penetrate the roof sheathing. Nails used to retain copper flashing shall be solid copper.

2.1.4 Flashing

Flashing shall be 20 ounce, light cold-rolled temper (H00) copper conforming to ASTM B 370. Flashing shall be in accordance with the requirements as specified in Section 07600 FLASHING AND SHEET METAL.

2.1.5 Sealants

Sealants, where required, shall be in accordance with the slate manufacturer's recommendations.

PART 3 EXECUTION

3.1 PROTECTION OF ROOF SURFACES

Equipment and techniques shall be used which prevents damage to the roof. Contractor shall be responsible for other trades working on or above completed roofing. Personnel who are working on the roof shall have proper shoes which will not damage roofing, and shoe soles shall be made of a material which will aid in preventing falls.

3.2 PREPARATION OF SURFACES

Roof deck surfaces shall be smooth, clean, firm, dry, and free from loose boards, large cracks, and projecting ends that might damage the roofing. Foreign particles shall be cleaned from interlocking areas to ensure proper seating and to prevent water damming. Prior to installation of slate, vents and other projections through roofs shall be properly flashed and secured in position, and projecting nails shall be driven firmly home.

3.3 ROOFING FELT

Felt shall be laid in horizontal layers with joints lapped toward eaves and at ends at least 2 inches, and secured along laps and at ends as necessary to hold the felt in place and protect the structure until covered with the roofing material. Felt shall be preserved unbroken, tight and whole. Felt shall lap hips and ridges at least 12 inches to form a double thickness and shall be lapped 2 inches over the metal of valleys. Roofing felt shall be on the roof deck where the membrane underlayment is not required.

3.4 ELASTOMERIC MEMBRANE UNDERLAYMENT

3.4.1 Surface Preparation

Dust, dirt, loose nails or other protrusions shall be removed.

3.4.2 Temperature

Membrane shall be applied only in fair weather when air and surface temperatures are above 40 degrees F.

3.4.3 Membrane Application

Membrane shall be applied according to manufacturer's instructions. Membrane shall be adhered directly to roof deck. The membrane shall be cut into 10 to 15 foot lengths and shall be re-rolled. The release paper shall be peeled back 1 to 2 feet; the membrane shall be aligned on the lower edge of the roof and the first 1 to 2 feet shall be placed. The release paper under the membrane shall be peeled from the membrane. The membrane shall be pressed in place. Lower edges shall be rolled firmly with a wallpaper or hand roller. Protection, membrane shall be applied at the building eaves and extend a minimum of 24" (measured horizontally) inside the interior face of the exterior wall. Ends and edges shall be overlapped a minimum of 6 inches. Membrane shall not be folded onto an exposed face of the roof edge.

3.4.4 Valley, Hip, and Ridge Application

The membrane shall be cut into 4 to 6 foot lengths. The release paper sheet shall be peeled and centered over the valley or ridge, then draped and pressed in place, working from the center of the valley or ridge outward in each direction. For valleys, membrane shall be applied starting at the low point and working upwards. All sheets shall be overlapped a minimum of 6 inches.

3.4.5 Protection

Elastomeric membrane underlayment shall not be left permanently exposed to sunlight. Membrane shall be covered with exposed roofing materials as soon as possible. Membrane damaged due to exposure to sunlight shall be patched prior to the application of final roof covering.

3.5 METAL FLASHING

Metal flashing shall be as shown at intersections of vertical or projecting surfaces through the roof or against which the roof abuts, such as sides of chimneys. Flashing installation shall be in accordance with Section 07600 FLASHING AND SHEET METAL.

3.6 SYNTHETIC SLATING

3.6.1 Synthetic Slate - CLass A Tile Installation

1. Beginning at the eave, install a layer of synthetic slate tiles gapped a minimum of 3/8" between tiles and any projections, with two roofing fasteners per tile (in location shown on tiles). This layer of tiles will become the starter row. Install another layer of tiles in the same manner as the first with the exception of the second layer having a 1/2 tile offset to the first layer.

2. Continue installing tiles with a 6" exposure.

3. Care must be taken to place tiles so color variations are evenly distributed over the entire roof area. Tiles between bundles and pallets MUST be shuffled to insure even distribution of color variations. "patchy" or "blotching" in appearance is not acceptable and the Contractor will be required to correct. It is recommended that work not begin until all roofing materials have been delivered to the job site.

4. It is the responsibility of the Contractor to insure that all synthetic slate tile are bent back in a downward curve prior to installation. Do not install tiles with an upward curve.

5. An open valley design shall be used:

   With an open valley design leave a minimum of 2" on each side of the valley exposed and uncovered by the roof tiles. A W-Style Valley metal shall be used.

6. Minimum Fastening - No less than 2 Fasteners per tile shall be used with a minimum length of 1 1/2".

7. CAUTION: When using a pneumatic nailer care should be taken to

insure that nails are not over driven causing the tiles to curl upwards, tiles will never lay flat. Overdriven tiles must be removed and re-nailed properly.

8. Install Attic ridge vent system per the manufacturer's application instructions, and then place the Synthetic Slate - formed Hip/Ridge Tile over the ridge vent. A minimum 2.5" stainless steel, hand-driven fastener should be used on an unventilated hip to fasten the Hip/Ridge Tile shall be installed with 6" exposure.

9. Synthetic Slate Tiles shall not be installed if the tiles have been stored in temperatures lower than 45º F. If tiles have been stored in temperatures below 45º F, tiles must be brought back to an ambient material temperature of 45º F. As the temperature rises Synthetic Slate will expand beyond the designed installation pattern if the product is installed while cold or frozen.

10. Do not install tiles directly adjacent to each other. A minimum gap of 3/8" must be maintained between installed tiles.

11. After the initial row of tiles has been installed, it is recommended that a chalk line be placed parallel to the roof edge and running perpendicular to the first row of tiles. this chalk line will insure that the tiles stay true and plumb to the roof edge throughout installation.

12. Care must be taken to minimize foot traffic over completed areas of the roof. Synthetic Slate tiles will show mud and dirt and cause appearance problems. The removal of dirt and debris is the responsibility of the Contractor.

13. Synthetic Slate Tiles can be slippery when wet, caution should be exhibited with early morning dew and after rain. The use of toe boards and OSHA approved harnesses and safety equipment at all times is recommended.

14. Upon completion of the roof system installation, inspect and remove all debris from roof, sweep clean and wash with a mild, non-bleaching detergent.

3.7 ACCESSORIES FOR SLATE ROOFS

3.7.1 Crickets

Vertical surfaces which project through the roof surface at a right angle to the slope of the roof shall have a cricket built into the roof to divert water away from the back of the vertical member. Crickets of light rafter construction covered with sheathing, underlayment, and copper sheet metal specified in Section07625 COPPER SHEET METAL FLASHING. If the cricket area is large and exposed to view, it shall be slated the same as other roof areas. Open-type valleys shall be formed with the main roof at cricket areas. Unless noted otherwise, the slope of the cricket shall be the same as the slope of the roof.

3.7.2 Snow Guards

Nonferrous metal show guards shall be provided as indicated.

-- End of Section --

SECTION 07625

COPPER SHEET METAL FLASHING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B 152/B 152M	(2000) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 32	(2004) Solder Metal
ASTM B 370	(2003) Copper Sheet and Strip for Building Construction
ASTM C 1136	(2003a) Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 2822	(1991; R 1997e1) Asphalt Roof Cement
ASTM F 547	(2001) Nails for Use with Wood and Wood-Base Materials

SHEET METAL AND AIR CONDITIONING ContractorRS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual	(2003, 6th Ed) Architectural Sheet Metal Manual

1.2 GENERAL REQUIREMENTS

Sheet metalwork shall be accomplished to form weathertight construction. Work shall be installed without waves, warps, buckles, fastening stresses or distortion and shall allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed by sheet metal mechanics. Exposed edges shall be hemmed. Bottom edges of exposed vertical surfaces shall be angled to form drips. Flashing at the end of a run shall be formed into a 3-dimensional configuration to direct water to the outside of the system. Weights and thicknesses of copper flashing shall be as specified in TABLE 1. Joints shall be installed as specified in TABLE 2. Accessories and other items essential to complete the sheet metal installation, though not specifically indicated or specified, shall be provided. Installation of sheet metal items used in conjunction with roofing shall be coordinated with roofing work to permit continuous roofing operations. Factory-fabricated components shall be

packed in cartons marked with the manufacturer's name or trademark printed or embossed at frequent intervals to permit easy identification. Sheet metalwork pertaining to heating, ventilating, and air conditioning is specified in other sections.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Sheet Metal

Drawings showing weights, gauges, or thickness of sheet metal; type of material; joining, expansion-joint spacing, and fabrication details; and installation procedures. Materials shall not be delivered to the site until after the approved detail drawings have been returned to the Contractor.

SD-03 Product Data

Contractor Quality Control

Quality Assurance Plan, including a checklist of points to be observed, prior to start of roofing work.

SD-04 Samples

Materials

Samples of materials proposed for use, upon request.

1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be adequately packaged and protected during shipment and shall be inspected for damage, dampness, and wet-storage stains upon delivery to the jobsite. Materials shall be clearly labeled as to type and manufacturer. Sheet metal items shall be carefully handled to avoid damage. Materials shall be stored in dry, weathertight, ventilated areas until installation.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall conform to the requirements specified below, and those given in TABLE 1. Materials exposed to weather shall be copper.

2.1.1 Bituminous Cement

ASTM D 2822, Type I.

2.1.2 Fasteners

Materials shall conform to TABLE 1. Nails shall conform to ASTM F 547 or be as approved. Nails and rivets shall be copper. Screws and bolts shall be bronze. Fasteners shall be the best type for the application.

2.1.3 Felt

ASTM D 226, Type II.

2.1.4 Flux

Type I.

2.1.5 Slip Sheet

Building paper meeting the requirements of ASTM C 1136, Type IV, style optional.

2.1.6 Sheet Metal

ASTM B 152/B 152M, ASTM B 370, Light cold-rolled temper (H00) copper.

2.1.7 Solder

ASTM B 32 Sn50.

2.2 SEALANTS AND SEALING COMPOUNDS

Sealants and sealing compounds are specified in Section 07920 JOINT SEALANTS.

PART 3 EXECUTION

3.1 GALVANIC ACTION

Galvanic action between copper and iron or steel shall be avoided by the use of proper insulation. The copper shall be insulated by the following: covering the steel member with insulation; placing strips of sheet lead between the two metals; or by heavily tinning the iron.

3.2 SOLDERING AND SEAMING

3.2.1 Soldering

Edges of sheet metals, except lead coated material shall be pretinned before soldering is begun. Soldering shall be done slowly with well heated soldering irons to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Edges of lead coated material to be soldered shall be scraped or wire-brushed to produce a bright surface, and seams shall have a liberal amount of flux brushed in before soldering is begun. Soldering shall follow immediately after application of the flux. Upon completion of soldering, the acid flux residue shall be thoroughly cleaned from the sheet metal with a solution of washing soda in water and rinsed with clean water.

3.2.2 Seams

Flat-lock and soldered-lap seams shall finish not less than 1 inch wide. Unsoldered plain-lap seams shall lap not less than 3 inches unless otherwise specified. Flat seams shall be made in the direction of the flow.

3.3 COVERING ON MINOR FLAT, PITCHED, OR CURVED SURFACES

Unless otherwise indicated, minor flat, pitched, or curved surfaces, such

as crickets, bulkheads, dormers, and small decks, shall be covered or flashed with 18 x 24 inch metal sheets and shall be secured with cleats. One ply of felt covered with 1 ply of slip sheet shall be applied as underlayment on wood surfaces. Two cleats shall be placed on the long side and 1 cleat shall be placed on the short side. Seams shall be locked and soldered.

3.4 CLEATS

A continuous cleat shall be provided where indicated or specified to secure loose edges of the sheet metalwork. Butt joints shall be spaced approximately 1/8 inch apart. The cleat shall be fastened to the supporting construction with nails evenly spaced not over 12 inches on centers. Where the fastening is to be made to concrete or masonry, screws shall be used and shall be driven in expansion shields set in concrete or masonry. The cleat for fascia anchorage shall be installed to extend below the supporting construction to form a drip and to allow the flashing to be hooked over the lower edge at least 3/4 inch. The cleat shall be of sufficient width to provide adequate bearing area to ensure a rigid installation. Where horizontal nailer is vented for insulation and the cleat is placed over masonry or concrete, the cleat shall be installed over 1/16 inch thick metal washers placed at screws. Washers shall be of metal that is electrolytically compatible with the continuous cleat.

3.5 EXPANSION JOINTS

Expansion joints shall be provided at 40 foot intervals, except that where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing, an additional joint shall be provided. Joints shall be evenly spaced.

3.6 FLASHINGS

3.6.1 General

Flashings shall be installed at intersections of roof with vertical surfaces and at projections through roof, except that flashing for heating and plumbing, including piping, roof, and floor drains, and for electrical conduit projections through roof or walls is covered in appropriate sections for such work. Cap flashings shall be turned around exterior corners of masonry or concrete walls at least 2 inches, shall be secured into masonry joints and into concrete with expansion anchors and shall be sealed with No. 2 or 4 sealing compound. Corner units shall have mitered joints, shall be installed with 3 inch lap joint over flashings on each side. Unless otherwise indicated, through-wall flashing shall be terminated 1/2 inch inside each exposed face of the wall. Cap flashings shall be provided over base flashings. Perforations in flashings made by masonry anchors shall be covered up by an application of bituminous plastic cement at the perforation. Exposed and unfastened flashings shall have the edge of the strip turned under 1/2 inch. Flashing shall be installed on top of joint reinforcement.

3.6.2 Base Flashings

(a) Base flashings shall extend under the uppermost row of tile the full depth of the tile or at least 4 inches over the tile immediately below the metal.

(b) The vertical leg of the metal shall be turned up not less than 4

inches and preferably 8 inches on the abutting surface. Where a vertical surface butts against the roof slope, the base flashing shall be built into each course of tile as it is laid, turning the metal out 4 inches on the tile and at least 8 inches above the roof.

(c) Where the roof stops against a stuccoed wall, a wood 2 x 4 with a bevelled top edge shall be secured to the wall. The base flashing shall then be turned out over the tile at least 4 inches and bent up vertically at least 3 inches on the board.

(d) The base flashing shall be turned out 4 inches on the roof surface and from 6 to 8 inches on the vertical surface for either sloping or flat slate roofs.

(e) Base flashings shall be used where posts, flagpoles, or scuttles project through the roof. Vent pipes shall have base flashings in the form of special sleeves and/or EPDM boots.

3.6.3 Cap Flashings (Counterflashings)

Where the base flashing is not covered by vertical tile or siding, a cap flashing shall be built into the masonry joints lapping not less than 2 inches vertically, extending down over the base flashing 4 inches, and the edge bent back and up 1/2 inch.

3.6.4 Stepped Flashing

Stepped flashing shall be installed where sloping roofs surfaced with tiles abut vertical surfaces. Separate pieces of base flashing shall be placed in alternate tile courses. Each piece of base flashing shall extend out onto the roof at least 4 inches and shall be nailed to the deck. The stepped base flashing shall extend up along the wall not less than 4 inches and stop beneath the cap flashing or shall be anchored beneath wood siding in frame construction. Cap flashings shall be set in a reglet into masonry and concrete construction, and cap flashing shall lap over the flashing below not less than 3 inches. The stepped base flashing at vertical joints between the sections shall be lapped not less than 3 inches.

3.6.5 Valley Flashing

Valley flashing shall be free from longitudinal seams and shall be of a width sufficient to extend not less than 6 inches under the roof covering on each side. The sheets shall lap not less than 8 inches in the direction of flow and shall be secured to roofing construction with cleats on each side. Cleats shall be spaced not more than 24 inches on centers. The copper sheet shall not be punctured with nails at any place.

3.6.5.1 Open Valley Flashings

(a) Open valleys shall be not less than 4 inches wide. The proper width shall be determined by the following rule: Starting at the top with a width of 4 inches, increase the width 1 inch for every 8 feet of length of the valley. Flashing pieces shall be full length sheets and of sufficient width to cover the open portion of the valley and extend up under the roofing not less than 6 inch on each side.

(b) Where two valleys of unequal size come together; where the areas

drained by the valley are unequal; where the slope of the valley is 26 degrees or less (6 inches or less per foot;) or where the intersecting roofs are of different slopes, an inverted V-joint 1 inch high, shall be provided along the centerline of the valley, and the edge of the valley sheets shall extend 8 inches under the roof covering on each side.

3.6.6 Through-Wall Flashing

Through-wall flashing includes sill, lintel, and spandrel flashing. The flashing shall be laid with a layer of mortar above and below the flashing so that the total thickness of the two layers of the mortar and flashing are the same thickness as the regular mortar joints. Flashing shall be one piece for lintels and sills.

3.6.6.1 Lintel Flashing

Lintel flashing shall extend the full length of lintel. It shall extend through the wall one masonry course above the lintels and shall be bent down over the top of masonry and precast concrete lintels. Bedjoints of lintels at control joints shall be underlaid with sheet metal bond breaker.

3.6.6.2 Sill Flashing

Sill flashing shall extend the full width of the sill and not less than 4 inches beyond ends of sill except at a control joint where the flashing shall be terminated at the end of the sill.

3.6.7 Eave and Rake Flashings

Eave and rake flashings shall be placed in accordance with SMACNA Arch. Manual.

3.7 DOWNSPOUTS

Downspouts shall be set plumb and not less than 1 inch from the wall. Leaders shall connect gutters on overhanging eaves to downspouts. Leaders shall be set with a slope not less than 0.3 degrees, 1/16 inch per foot or more than 30 degrees below a horizontal line. Leaders shall fit over the outlet tube in gutter bottom and shall fit into and be riveted to the downspout. Rivet spacing shall be not more than 2 inches. Strainers shall be set loosely in the eave tube opening in gutter. Joints between lengths of downspouts shall be made by telescoping the end of the upper lengths at least 3/4 inch into the lower length. Downspouts terminating in drainage lines shall be neatly fitted into downspout boots and the joint filled with a portland cement mortar cap sloped away from downspout. Downspout hangers shall be provided adjacent to the joint at the top of each section of downspout, except that the bottom section shall have an additional strap adjacent to the bottom joint when splash blocks or splash pans are required. Hangers shall be 1/16 x 1 inch flat stock of the same material as the downspout.

3.8 GUTTERS

Gutters shall terminate at least 1/2 inch away from vertical surfaces. Gutter brackets and spacers shall be fastened to roof nailer by screws or deformed shank-type nails and shall interlock with or be fastened to the leading edge of gutter. Gutter spacers shall be 1/16 x 1 inch flat-stock of the same material as the gutter. Brackets and spacers shall be

alternated at not more than 36 inches on centers. Gutters shall be hung with high points at ends or equidistant from downspouts and shall have a slope of not less than 1/16 inch per foot.

3.9 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.

b. Verification of compliance of materials before, during, and after installation.

c. Inspection of sheet metalwork, for proper size and thickness, fastening and joining, and proper installation.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer at the end of each day.

TABLE 1 - COPPER SHEET METAL WEIGHTS AND THICKNESSES

Item Description	Copper, kilogram per square foot
Cleats (Continuous)	24
Covering on minor flat, pitched or curved surfaces	20
Downspouts, heads and leaders	16
Flashings:	
Base	20
Cap, stepped or valley	16
Gutters (girth):	
Up to 380 mm	16
380 to 510 mm	16
510 to 635 mm	20
635 to 760 mm	24
Gutter brackets (girth):	
Up to 380 mm	1/8 x 1 inch
380 to 510 mm	1/4 x 1 inch
510 to 610 mm	1/4 x 1 1/2 inch
Gutter cleats and cover plates	16
Strainers (wire gauge)	No.9
Through-wall, flashings above roof line	16
Through-wall, below roof line, except as otherwise specified in paragraph MATERIALS	10

TABLE 2 - COPPER SHEET METAL JOINTS

Item Designation	Type of Joint
Cleats (Continuous)	Butt
Flashings:	
Base	1 inch flat locked, soldered. 3 inch lap for expansion joint.
Stepped	3 inch lap.
Valley	6 inch lap, cleated.
Gutters	1 1/2 inch lap, riveted and soldered.

-- End of Section --

SECTION 07920

JOINT SEALANTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 834	(2000e1) Latex Sealants
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM D 1056	(2000) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber

1.2 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sealants

Primers

Bond breakers

Backstops

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required).

Certificates of compliance stating that the materials conform to the specified requirements.

MSDS of all field applied sealants used within the building interior, highlighting VOC content.

1.3 ENVIRONMENTAL CONDITIONS

Apply sealant when the ambient temperature is between 40 and 90 degrees F.

1.4 DELIVERY AND STORAGE

Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, color and material designation clearly marked thereon. Label elastomeric sealant containers to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to

sustained temperatures exceeding 90 degrees F or less than 0 degrees F.

1.5 QUALITY ASSURANCE

1.5.1 Compatibility with Substrate

Verify that each of the sealants are compatible for use with joint substrates.

1.5.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed instructions.

1.5.3 Mock-Up

Project personnel is responsible for installing sealants in mock-up prepared by other trades, using materials and techniques approved for use on the project.

1.6 SPECIAL WARRANTY

Guarantee sealant joint against failure of sealant and against water penetration through each sealed joint for five years.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied.

All sealants applied on the building interior shall have a VOC content not more than 250 g/l

2.1.1 Interior Sealant

Provide ASTM C 834. Location(s) and color(s) of sealant for the following:

	LOCATION	COLOR
a.	Small voids between walls or partitions and adjacent casework, door frames, built-in or surface-mounted equipment and fixtures, and similar items.	White
b.	Perimeter of frames at doors, and windows, which adjoin exposed interior concrete and masonry surfaces.	White
c.	Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	White
d.	Joints between edge members for acoustical tile and adjoining vertical surfaces.	White
e.	Interior locations, not otherwise indicated	White

	or specified, where small voids exist between materials specified to be painted.	
f.	Behind escutcheon plates at valve pipe penetrations and showerheads in showers.	White

2.1.2 Exterior Sealant

For joints in vertical surfaces, provide ASTM C 920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C 920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows:

	LOCATION	COLOR
a.	Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry.	Match brick color color
b.	Masonry joints where shelf angles occur.	Match brick color
c.	Joints in wash surfaces of stonework.	Match adjacent surfaces
d.	Expansion and control joints.	Match brick color
e.	Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.	Match adjacent surface color
f.	Voids where items pass through exterior walls.	Match brick color

2.1.3 Floor Joint Sealant

ASTM C 920, Type S or M, Grade P, Class 25, Use T. Provide location(s) and color(s) of sealant as follows:

	LOCATION	COLOR
a.	Seats of metal thresholds for exterior doors.	Gray

2.2 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.3 BOND BREAKERS

Provide the type and consistency recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.4 BACKSTOPS

Provide neoprene, foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized

backing for closed cell material, unless otherwise indicated. Make backstop material compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

2.4.1 Neoprene

Conform to ASTM D 1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2 Neoprene backing.

2.5 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer except for aluminum and bronze surfaces that will be in contact with sealant.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean surfaces from dirt frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Remove oil and grease with solvent. Surfaces must be wiped dry with clean cloths. When resealing an existing joint, remove existing calk or sealant prior to applying new sealant. For surface types not listed below, contact sealant manufacturer for specific recommendations.

3.1.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

3.1.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. For removing protective coatings and final cleaning, use nonstaining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.1.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Laitance, remove efflorescence and loose mortar from the joint cavity.

3.1.4 Wood Surfaces

Keep wood surfaces to be in contact with sealants free of splinters and sawdust or other loose particles.

3.2 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealant. Mix multicomponent elastomeric sealants in accordance with manufacturer's instructions.

3.3 APPLICATION

3.3.1 Joint Width-To-Depth Ratios

a. Acceptable Ratios:

JOINT WIDTH	JOINT DEPTH	
	Minimum	Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For wood, concrete, or masonry:		
1/4 inch (minimum)	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 2 inch	1/2 inch	5/8 inch

b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is not required on metal surfaces.

3.3.2 Masking Tape

Place masking tape on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Remove masking tape within 10 minutes after joint has been filled and tooled.

3.3.3 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

a. Where indicated.

b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios."

3.3.4 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

3.3.5 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

3.3.6 Sealants

Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Make sealant uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified. Apply sealer over the sealant when and as specified by the sealant manufacturer.

3.4 PROTECTION AND CLEANING

3.4.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

3.4.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.

b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent-moistened cloth.

-- End of Section --

SECTION 08110

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A250.6	(1997) Hardware on Standard Steel Doors (Reinforcement - Application)
ANSI A250.8	(1998) SDI-100 Recommended Specifications for Standard Steel Doors and Frames

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2004) Structural Welding Code-Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 591	(1998) Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Mass Applications
ASTM A 653/A 653M	(2001a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C 578	(2004) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(2001) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 612	(2004) Mineral Fiber Block and Board Thermal Insulation
ASTM D 2863	(2000) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA))

BHMA A115	(1991) Steel Door Preparation Standards (Consisting of A115.1 through A115.6 and A115.12 through A115.18)

STEEL DOOR INSTITUTE (SDI)

SDI 105	(1998) Recommended Erection Instructions for Steel Frames
SDI 111-C	Recommended Louver Details for Standard Steel Doors
SDI 113	(1979) Apparent Thermal Performance of STEEL DOOR and FRAME ASSEMBLIES

1.2 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:
SD-02 Shop Drawings

Doors

Frames

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors

Schedule of frames

Submit door and frame locations.

SD-03 Product Data

Doors

Frames

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction.

Location(s) of product manufacture and of harvest/ extraction/ recovery of primary materials used in product. Designation of the percentages of post-consumer and pre-consumer recycled-content in door and frame materials.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

ANSI A250.8, except as specified otherwise. Prepare doors to receive door hardware. Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 1-3/4 inch thick, unless otherwise indicated.

Provide steel doors with a minimum 30% recycled content. Give preference to products manufactured and of primary raw materials harvested/ extracted/ recovered within a 500-mile radius of the Project Site.

2.1.1 Classification - Level, Performance, Model

2.1.1.1 Extra Heavy Duty Doors

ANSI A250.8, Level 3, physical performance Level A, Model 1 with fully insulated core construction as required by the manufacturer for interior doors and for exterior doors, of size(s) and design(s) indicated. Door faces shall be embossed with a "Six-panel" design with the bottom rail measuring 12" high from the floor for ADAAG compliance.

2.2 ACCESSORIES

2.2.1 Louvers

2.2.1.1 Interior Louvers

SDI 111-C, Louvers shall be stationary sightproof type where scheduled. Detachable moldings on room or non security side of door; on security side of door, moldings to be integral part of louver. Form louver frames of 20 gage steel and louver blades of a minimum 24 gage. Sightproof louvers to be inverted "V" blade design with minimum 55 percent net-free opening.

2.2.1.2 Exterior Louvers

Louvers shall be inverted "V" type with minimum of 55 percent net-free opening. Weld or tenon louver blades to continuous channel frame and weld assembly to door to form watertight assembly. Form louvers of hot-dip galvanized steel of same gage as door facings. Louvers shall have steel-framed insect screens secured to room side and readily removable. Net-free louver area to be before screening.

2.2.2 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08710 DOOR HARDWARE provide overlapping steel astragals with the doors.

2.3 INSULATION CORES

Insulated cores shall be of type specified, and provide an apparent U-factor of .48 in accordance with SDI 113 and shall conform to:

a. Rigid Polyurethane Modified Polyisocyanurate Foam: ASTM C 591, Type I or II, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D 2863; or

b. Rigid Polystyrene Foam Board: ASTM C 578, Type I or II; or

c. Mineral board: ASTM C 612, Type I.

2.4 STANDARD STEEL FRAMES

ANSI A250.8, Level 3, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors and transoms, unless otherwise indicated.

Provide steel frames with a minimum 30 percent recycled content. Give preference to products manufactured and of primary raw materials harvested/ extracted/ recovered within a 500-mile radius of the Project Site.

2.4.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

Weld frames in accordance with the recommended practice of the Structural Welding Code Sections 1 through 6, AWS D1.1/D1.1M and in accordance with the practice specified by the producer of the metal being welded.

2.4.2 Mullions and Transom Bars

Mullions and transom bars shall be closed or tubular construction and be a member with heads and jambs butt-welded thereto. Bottom of door mullions shall have adjustable floor anchors and spreader connections.

2.4.3 Stops and Beads

Form stops and beads from 20 gage steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inch on center. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.4.4 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 18 gage.

2.4.4.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped;

2.5 WEATHERSTRIPPING

As specified in Section 08710 DOOR HARDWARE.

2.6 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in ANSI A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of ANSI A250.8 and ANSI A250.6. For additional requirements refer to BHMA A115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of ANSI A250.8, as applicable. Punch door frames, with the exception of frames that will have weatherstripping to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.7 FINISHES

2.7.1 Factory-Primed Finish

All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in ANSI A250.8.

2.7.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A 924/A 924Mand ASTM A 653/A 653M. The coating weight shall meet or exceed the minimum requirements for coatings having 0.4 ounces per square foot, total both sides, i.e., A40. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in ANSI A250.8.

2.7.3 Electrolytic Zinc-Coated Anchors and Accessories

Provide electrolytically deposited zinc-coated steel in accordance with ASTM A 591, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in ANSI A250.8.

2.8 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. On wraparound frames for masonry partitions, provide a throat opening 1/8 inch larger than the actual masonry thickness. Design frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive calking compound.

2.8.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI 105. Plumb, align, and brace securely until permanent anchors are set. Build in or secure wall anchors to adjoining construction. Backfill frames with mortar. Coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

3.1.2 Doors

Hang doors in accordance with clearances specified in ANSI A250.8. After erection and glazing, clean and adjust hardware.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

-- End of Section --

SECTION 08120

ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2604	(2002) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

ASTM INTERNATIONAL (ASTM)

ASTM A 36/A 36M	(2000) Carbon Structural Steel
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2004a) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM E 283	(1991; R 1999) Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 331	(2000) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

1.2 PERFORMANCE REQUIREMENTS

1.2.1 Structural

Shapes and thicknesses of framing members shall be sufficient to withstand a design wind load of not less than 30 pounds per square foot of supported area with a deflection of not more than 1/175 times the length of the member and a safety factor of not less than 1.65. Provide glazing beads, moldings, and trim of not less than 0.050 inch nominal thickness.

1.2.2 Air Infiltration

When tested in accordance with ASTM E 283, air infiltration shall not exceed 0.06 cubic feet per minute per square footof fixed area at a test pressure of 6.24 pounds per square foot (50 mile per hour wind).

1.2.3 Water Penetration

When tested in accordance with ASTM E 331, there shall be no water penetration at a pressure of 8 pounds per square foot of fixed area.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors and frames

Show elevations of each door type, size of doors and frames, metal gages, details of door and frame construction, methods of anchorage, glazing details, weatherstripping, provisions for and location of hardware, and details of installation.

SD-03 Product Data

Doors and FramesSD-

Location(s) of product manufacture and of harvest/ extraction/ recovery of primary materials used in product.

SD-08 Manufacturer's Instructions

Doors and frames

Submit detail specifications and instructions for installation, adjustments, cleaning, and maintenance.

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site for damage. Unload and store with minimum handling. Provide storage space in dry location with adequate ventilation, free from dust or water, and easily accessible for inspection and handling. Stack materials on nonabsorptive strips or wood platforms. Do not cover doors and frames with tarps, polyethylene film, or similar coverings. Protect finished surfaces during shipping and handling using manufacturer's standard method, except that no coatings or lacquers shall be applied to surfaces to which calking and glazing compounds must adhere.

1.5 FIELD MEASUREMENTS

Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 DOORS AND FRAMES

Swing-type aluminum doors and frames of size, design, and location indicated. Provide doors complete with frames, framing members, subframes, transoms, adjoining sidelights, trim, and accessories.

Give preference to products manufactured and of primary raw materials harvested/ extracted/ recovered within a 500-mile radius of the Project Site.

2.2 MATERIALS

2.2.1 Anchors

Stainless steel.

2.2.2 Weatherstripping

Continuous wool pile, silicone treated, or type recommended by door manufacturer.

2.2.3 Aluminum Alloy for Doors and Frames

ASTM B 221, Alloy 6063-T5 for extrusions. ASTM B 209, alloy and temper best suited for aluminum sheets and strips.

2.2.4 Fasteners

Hard aluminum or stainless steel.

2.2.5 Structural Steel

ASTM A 36/A 36M.

2.3 FABRICATION

2.3.1 Aluminum Frames

Extruded aluminum shapes with contours approximately as indicated. Provide removable glass stops and glazing beads for frames accommodating fixed glass. Use countersunk stainless steel Phillips screws for exposed fastenings, and space not more than 12 inches on center. Mill joints in frame members to a hairline fit, reinforce, and secure mechanically.

2.3.2 Aluminum Doors

Of type, size, and design indicated and not less than 1-3/4 inch thick. Minimum wall thickness, 0.125 inch, except beads and trim, 0.050 inch. Door sizes shown are nominal and shall include standard clearances as follows: 0.093 inch at hinge and lock stiles, 0.125 inch between meeting stiles, 0.125 inch at top rails, 0.187 inch between bottom and threshold, and 0.687 inch between bottom and floor. Bevel single-acting doors 0.063 or 0.125 inch at lock, hinge, and meeting stile edges.

2.3.2.1 Full Glazed Stile and Rail Doors

Doors shall have medium stiles and rails as indicated. Fabricate from extruded aluminum hollow seamless tubes or from a combination of open-shaped members interlocked or welded together. Fasten top and bottom rail together by means of welding or by 3/8 or 1/2 inch diameter cadmium-plated tensioned steel tie rods. Provide an adjustable mechanism of jack screws or other methods in the top rail to allow for minor clearance adjustments after installation.

2.3.3 Welding and Fastening

Where possible, locate welds on unexposed surfaces. Dress welds on exposed surfaces smoothly. Select welding rods, filler wire, and flux to produce a uniform texture and color in finished work. Remove flux and spatter from

surfaces immediately after welding. Exposed screws or bolts will be permitted only in inconspicuous locations, and shall have countersunk heads. Weld concealed reinforcements for hardware in place.

2.3.4 Weatherstripping

Provide on stiles and rails of exterior doors. Fit into slots which are integral with doors or frames. Weatherstripping shall be replaceable without special tools, and adjustable at meeting rails of pairs of doors. Installation shall allow doors to swing freely and close positively. Air leakage of a single leaf weatherstripped door shall not exceed 0.5 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283.

2.3.5 Anchors

On the backs of subframes, provide anchors of the sizes and shapes indicated for securing subframes to adjacent construction. Anchor transom bars at ends and mullions at head and sill. Place anchors near top and bottom of each jamb and at intermediate points not more than 25 inch apart.

2.3.6 Provisions for Hardware

Coordinate with Section 08710 DOOR HARDWARE. Deliver hardware templates and hardware (except field-applied hardware) to the door manufacturer for use in fabrication of aluminum doors and frames. Cut, reinforce, drill, and tap doors and frames at the factory to receive template hardware. Provide doors to receive surface-applied hardware, except push plates, kick plates, and mop plates, with reinforcing only; drill and tap in the field. Provide hardware reinforcements of stainless steel or steel with hot-dipped galvanized finish, and secure with stainless steel screws.

2.3.7 Provisions for Glazing

Provide extruded aluminum snap-in glazing beads on interior side of doors. Provide extruded aluminum, theft-proof, snap-in glazing beads or fixed glazing beads on exterior or security side of doors. Glazing beads shall have vinyl insert glazing gaskets. Design glazing beads to receive glass of thickness indicated or specified.

2.3.8 Finishes

Provide exposed aluminum surfaces with factory finish of anodic coating or organic coating.

2.3.8.1 Organic Coating

Clean and prime exposed aluminum surfaces. Provide a high-performance finish in accordance with AAMA 2604 with total dry film thickness of not less than 1.2 mils. The finish color shall be as indicated on the drawings.

PART 3 EXECUTION

3.1 INSTALLATION

Plumb, square, level, and align frames and framing members to receive doors, transoms, and , adjoining sidelights. Anchor frames to adjacent construction as indicated and in accordance with manufacturer's printed instructions. Anchor bottom of each frame to rough floor construction with

3/32 inch thick stainless steel angle clips secured to back of each jamb and to floor construction; use stainless steel bolts and expansion rivets for fastening clip anchors. Hang doors to produce clearances specified in paragraph entitled "Aluminum Doors," of this section. After erection and glazing, adjust doors and hardware to operate properly.

3.2 PROTECTION FROM DISSIMILAR MATERIALS

3.2.1 Dissimilar Metals

Where aluminum surfaces come in contact with metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact to dissimilar metals.

3.2.1.1 Protection

Provide one of the following systems to protect surfaces in contact with dissimilar metals:

a. Paint the dissimilar metal with one coat of heavy-bodied bituminous paint.

b. Apply a good quality elastomeric sealant between the aluminum and the dissimilar metal.

3.2.2 Masonry and Concrete

Provide aluminum surfaces in contact with mortar, concrete, or other masonry materials with one coat of heavy-bodied bituminous paint.

3.2.3 Wood or Other Absorptive Materials

Provide aluminum surfaces in contact with absorptive materials subject to frequent moisture, and aluminum surfaces in contact with treated wood, with two coats of aluminum paint or one coat of heavy-bodied bituminous paint. In lieu of painting the aluminum, the Contractor shall have the option of painting the wood or other absorptive surface with two coats of aluminum paint and sealing the joints with elastomeric sealant.

3.3 CLEANING

Upon completion of installation, clean door and frame surfaces in accordance with door manufacturer's written recommended procedure. Do not use abrasive, caustic, or acid cleaning agents.

3.4 PROTECTION

Protect doors and frames from damage and from contamination by other materials such as cement mortar. Prior to completion and acceptance of the work, restore damaged doors and frames to original condition, or replace with new ones.

-- End of Section --

SECTION 08330

OVERHEAD ROLLING DOORS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE Fundamentals Handbook	(2005) Fundamentals Handbook

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M	(2001a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM E 330	(1997e01) Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials

1.2 DESCRIPTION

Overhead rolling doors shall be spring counterbalanced, rolling type, with interlocking slats, complete with guides, fastenings, hood, brackets, and operating mechanisms, and shall be designed for use on openings as indicated. Each door shall be provided with a permanent label showing the manufacturer's name and address and the model/serial number of the door. Doors in excess of the labelled size shall be deemed oversize and shall be provided with a listing agency oversize label, or a listing agency oversize certificate, or a certificate signed by an official of the manufacturing company certifying that the door and operator have been designed to meet the specified requirements.

1.2.1 Wind Load Requirements

Doors and components shall be designed to withstand the minimum design wind load of 30 psf. Doors shall be constructed to sustain a superimposed load, both inward and outward, equal to 1-1/2 times the minimum design wind load. Test data showing compliance with design windload requirements for the specific door design tested in accordance with the uniform static air pressure difference test procedures of ASTM E 330 shall be provided. Recovery shall be at least 3/4 of the maximum deflection within 24 hours after the test load is removed. Sound engineering principles may be used to interpolate or extrapolate test results to door sizes not specifically tested

1.2.2 Operational Cycle Life

All portions of the door and door operating mechanism that are subject to movement, wear, or stress fatigue shall be designed to operate through a minimum number of 10 cycles per day. One complete cycle of door operation is defined as when the door is in the closed position, moves to the full open position, and returns to the closed position.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings
Installation

Drawings showing the location of each door including schedules. Drawings shall include elevations of each door type, details and method of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, details of joints and connections, and details of guides, power operators, controls, and other fittings.

SD-03 Product Data

Overhead Rolling Doors

Manufacturer's catalog data, test data, and summary of forces and loads on the walls/jambs.

Location(s) of product manufacture and of harvest/ extraction/ recovery of primary materials used in product. Designation of the percentages of post-consumer and pre-consumer recycled-content in door materials.

SD-04 Samples

Overhead Rolling Doors

Submit three color samples of factory applied finishes.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

System operation manual and system maintenance and repair manual as indicated in Section 01781.

1.4 DELIVERY AND STORAGE

Doors shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Doors shall be stored in a dry location that is adequately ventilated and free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

1.6 OPERATION AND MAINTENANCE MANUALS

Operating instructions outlining the step-by-step procedures required for motorized door and shutter operation for the overhead rolling door unit shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as installed shall be provided. A complete list of parts and supplies, source of supply, and a list of the high mortality maintenance parts shall be provided.

PART 2 PRODUCTS

2.1 OVERHEAD ROLLING DOORS

Doors shall be surface-mounted type with guides at jambs set back a sufficient distance to clear the opening. Exterior doors shall be mounted as indicated on interior side of walls.

Give preference to products having recycled content and manufactured and of primary raw materials harvested/ extracted/ recovered within a 500-mile radius of the Project Site.

2.1.1 Curtains

The curtains shall roll up on a barrel supported at the head of opening on brackets, and shall be balanced by helical torsion springs. Steel slats for doors less than 15 feet wide shall be minimum bare metal thickness of 0.0281 inches. Slats shall be of the minimum bare metal decimal thickness required for the width indicated and the wind pressure specified above. Slats for fire doors over 12 feet wide and under 20 feet wide shall be not less than 0.0329 inches steel.

2.1.1.1 Insulated Curtains

The slat system shall supply a minimum R-value of 4 when calculated in accordance with ASHRAE Fundamentals Handbook. Slats shall be of the flat type as standard with the manufacturer. Slats shall consist of a urethane or polystyrene core not less than 11/16 inch thick, completely enclosed within metal facings. Exterior face of slats shall be gauge as specified for curtains. Interior face shall be not lighter than 0.0219 inches. The insulated slat assembly shall have a flame spread rating of not more than 25 and a smoke development factor of not more than 50 when tested in accordance with ASTM E 84.

2.1.2 Endlocks and Windlocks

The ends of each alternate slat for interior doors shall have steel endlocks of manufacturer's stock design. In addition to endlocks, non-rated exterior doors shall have the manufacturer's standard windlocks as required to withstand the wind load. Windlocks shall prevent the curtain from leaving guides because of deflection from specified wind

pressure.

2.1.3 Bottom Bar

The curtain shall have a standard bottom bar consisting of two hot-dip galvanized steel angles for steel doors.

2.1.4 Guides

Guides shall be steel structural shapes or formed steel shapes, of a size and depth to provide proper clearance for operation and resistance under the design windload. Guides shall be attached to adjoining construction with fasteners recommended by the manufacturer. Spacing of fasteners shall be as required to meet the minimum design windload. Doors and guides in hazardous areas shall have static grounding.

2.1.5 Barrel

The barrel shall be steel pipe or commercial welded steel tubing of proper diameter for the size of curtain. Deflection shall not exceed 0.03 inch per foot of span. Ends of the barrel shall be closed with metal plugs, machined to fit the pipe. Aluminum plugs are acceptable on non-fire door barrels.

2.1.6 Springs

Oil tempered helical steel counter-balance torsion springs shall be installed within the barrel and shall be capable of producing sufficient torque to assure easy operation of the door curtain. Access shall be provided for spring tension adjustment from outside of the bracket without removing the hood.

2.1.7 Brackets

Brackets shall be of steel plates to close the ends of the roller-shaft housing, and to provide mounting surfaces for the hood. An operation bracket hub and shaft plugs shall have sealed prelubricated ball bearings.

2.1.8 Hoods

Hoods shall be steel with minimum bare metal thickness of 0.0219 inches formed to fit contour of the end brackets, and shall be reinforced with steel rods, rolled beads, or flanges at top and bottom edges. Multiple segment and single piece hoods shall be provided with support brackets of the manufacturer's standard design as required for adequate support.

2.1.9 Weatherstripping

Exterior doors shall be fully weatherstripped. A compressible and replaceable weather seal shall be attached to the bottom bar. Weather seal at door guides shall be continuous vinyl or neoprene, bulb or leaf type, or shall be nylon-brush type. A weather baffle shall be provided at the lintel or inside the hood. Weatherstripping shall be easily replaced without special tools.

2.1.10 Operation

Doors shall be operated by means of manual push-up.

2.1.10.1 Manual Push-Up Operation

One lifting handle shall be provided on each side of the door. The maximum force required for lift-handle operation shall not exceed 25 lbf. Pull-down straps or pole hooks shall be provided on bottom rail of doors over 7 feet high.

2.1.11 Locking

Locking shall consist of interior slide bolts, suitable for padlock by others, for manual push-up doors.

2.1.12 Finish

Steel slats and hoods shall be hot-dip galvanized G60 in accordance with ASTM A 653/A 653M, and shall be treated for paint adhesion and shall receive a factory baked-on prime coat for field finishing. Surfaces other than slats, hood, and faying surfaces shall be cleaned and treated to assure maximum paint adherence and shall be given a factory dip or spray coat of rust inhibitive metallic oxide or synthetic resin primer.

PART 3 EXECUTION

3.1 INSTALLATION

Doors shall be installed in accordance with approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, hardware, and other accessories shall be accurately located. Upon completion, doors shall be free from warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely.

3.2 FIELD PAINTED FINISH

Steel doors and frames shall be field painted in accordance with Section 09900 PAINTING, GENERAL. Weatherstrips shall be protected from paint. Finish shall be free of scratches or other blemishes. Color shall be as indicated on the drawings.

-- End of Section --

SECTION 08460

AUTOMATIC ENTRANCE DOORS

PART 1 GENERAL

1.1 SUMMARY

A. WORK INCLUDED: Furnish complete automatic aluminum door system, as specified, that has been manufactured, fabricated and installed to maintain performance criteria stated by manufacturer without defects, damage or failure.

1.2 REFERENCES

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101	(1997) Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1.2	(2004) Safety Glazing Materials Used in Buildings
ANSI A156.10	(2004) Power Operated Pedestrian doors; Sliding Doors section.

ASTM INTERNATIONAL (ASTM)

ASTM B 221	(2004a) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2003) Life Safety Code

1.3 SUBMITTALS

A. PRODUCT DATA: Submit manufacturer's complete product and installation data. Provide location(s) of product manufacture and of harvest/ extraction/ recovery of primary materials used in product.

B. SHOP DRAWINGS: Submit drawings showing layout, profiles, product components including anchorage, accessories, finish and glazing details (where required).

C. QUALITY ASSURANCE AND CLOSEOUT SUBMITTALS: Submit the following:

1. Manufacturer's Operation and Maintenance Data in accordance with Section 01781.

2. Warranty document as specified herein.

3. AAADM inspection compliance form completed and signed by certified AAADM inspector prior to doors being placed in operation as proof of compliance with ANSI A156.10.

1.4 QUALITY ASSURANCE

A. INSTALLERS QUALIFICATIONS: Installer experienced (as determined by contractor) to perform work of this section who has specialized in the installation of work similar to that required for this project and who is acceptable to product manufacturer.

B. MANUFACTURER'S QUALIFICATIONS: Manufacturer to have minimum (5) five years successful experience in the fabrication of automatic doors of the type required for this project. Manufacturer capable of providing field service representation during installation, approving acceptable installer and approving application method.

1.5 WARRANTIES

A. MANUFACTURER'S WARRANTY: Units to be warranted against defect in material and workmanship for a period of one year from the Date of Substantial Completion. Manufacturer's warranty is in addition to, and not a limitation of, other rights owner may have under Contract Documents.

B. DISTRIBUTOR'S WARRANTY: One year warranty: Labor and transportation charges for defective parts replacement.

1.6 PROJECT CONDITIONS

FIELD MEASUREMENTS: Verify actual dimensions/openings by field measurements before fabrication and record on shop drawings. Coordinate with fabrication and construction schedule to avoid construction delays.

1.7 DELIVERY, STORAGE AND HANDLING

A. ORDERING AND DELIVERY: Comply with factory's ordering instructions and lead time requirements. Delivery shall be in factory's original, unopened, undamaged containers with identification labels intact.

B. STORAGE AND PROTECTION: Provide protection from exposure to harmful weather conditions and vandalism.

PART 2 PRODUCTS

2.1 MANUFACTURED DOOR UNITS:

A. MANUFACTURED DOOR UNITS: Shall include operator, header and track, jambs, sliding door panel(s), and sidelite(s). Units shall be mounted within rough opening with sliding panel(s) sliding along sidelite. Units shall be bipart and will have slide-swing panels that slide along exterior side. Give preference to products manufactured and of primary raw materials harvested/ extracted/ recovered within a 500-mile radius of the Project Site.

B. OPERATOR: The Electric Operating Mechanism shall be integral to the door unit. The operator shall be mounted and concealed within the header.

1. Microprocessor Master Control shall have Version 1 software and have dual on-board seven-segment diagnostic display. The control shall have minimum of 28 programmable parameters including those functions required by ANSI A156.10. Control shall include separate day and night modes of operation with security over-ride. Adjustable Reversing Circuit will reopen door unit if closing path is obstructed. Maximum force required to prevent sliding panel from closing = 28 lbf.

2. Finger Safety: When unit slides open, strike rail of sliding panel will stop short of adjacent sidelite; resulting opening is net slide.

3. On/Off Switch shall be supplied. When switched OFF, unit reverts to free manual operation (likewise during electrical power failure).

C. HEADER: Shall be aluminum construction with reinforcement for dead load and lateral strength. Header shall have removable face plate.

D. HEADER TRACK: Shall be be aluminum, nylon covered, and replaceable. Rollers will be steel, high quality ball bearing wheels. Anti-Derailing shall be accomplished by means of a continuous aluminum extrusion full length of slide panel travel.

E. SLIDING PANELS AND SIDELITES: Shall be aluminum, 1-3/4" (44 mm) deep with medium stile construction. Weather-stripping to be along perimeter of sliding panel(s) and swing-out sidelite(s). Concealed guides to stabilize bottom of sliding panel. Standard glazing prep to be for 1" insulating glass. Provide applied muntin(s) of size and type indicated for sliding panels and sidelites.

F. EMERGENCY EGRESS: Slide-swing panels can swing out at least 90° from any position of slide movement and require no more than 50 lbf. of force applied at the lock stile to open.

1. Slide-swing panels and swing-out sidelites shall have torsion spring designed to re-close panel if pushed open in the direction of egress.

2. Breakout mechanism shall provide support across full width of the door, in normal operating mode. In breakout mode, torsion assembly shall support weight of the door to minimize drop during emergency egress.

3. Units with emergency egress feature are UL listed as an exit way and are compliant with NFPA 101.

G. JAMBS/FRAME: Shall be aluminum. Jamb dimensions to be:

1. 1 3/4" (44 mm) deep by 4" (102 mm) wide.

2. Transom of size and type indicated, mounted on header.

H. THRESHOLD: Shall be aluminum, 1/2" (25 mm) tall by 4" (102 mm) wide.

I. HARDWARE: Provided and installed in strike rail shall be:

1. Hookbolt Lock latching into jamb or adjacent strike rail.

2. Maximum Security Lock with 31/32" (25 mm) backset.

3. Keyed Cylinder mounted on exterior side with 1 5/32" (29 mm) standard size cylinder. Compatible with building keying system.

4. Keyed cylinder on interior side.

5. Lockbolt into breakout carrier frame.

6. Additional Hardware:

a. Lockbolt into breakout carrier frame without hookbolt.

b. Flush Panic Exit Device recessed in muntin bar.

2.2 RELATED EQUIPMENT

BASIC SENSOR SYSTEM: Shall be 24 VDC, class ll circuit and shall be adjusted and installed in compliance with ANSI A156.10 System shall include the following:

A. ACTIVATION SENSORS: Microwave or active infrared sensor shall be header-mounted each side of door unit for detection of traffic from each direction.

B. THRESHOLD PRESENCE SENSORS:

1. Header mounted sensors shall provide active infrared presense detection on each side of the door unit and shall remain active throughout the entire door opening and closing cycle.

2. Hold-open beams: Two pulsed infrared photoelectric beams to be mounted in vertical rails of sidelite or in jambs. Sender/receiver arrangement parallels door opening.

2.3 RELATED WORK REQUIREMENTS

A. ELECTRICAL: 120 VAC, 50/60 cycle, single phase, dedicated 20 amp circuit per operator.

B. GLASS AND GLAZING: Glass stops, glazing vinyl and setting blocks for field glazing as per Safety Glazing standard ANSI Z97.1.2. Contractor to coordinate acquisition of glass in thickness and type in accordance with manufacturer's recommendations for prescribed design.

2.4 MATERIALS, FINISHES AND FABRICATION

A. EXTRUDED ALUMINUM: ASTM B 221, 6063-T5 alloy and temper, anodized:

1. Structural Header Sections: Minimum 3/16" (5 mm) thickness.

2. Structural Frame Sections: Minimum 1/8" (3 mm) thickness.

3. Structural Panel Sections: Commercial grade.

B. FINISHES (for all exposed aluminum surfaces): Shall be one of the

following:

1. Special Paint Coating: 50 percent fluoropolymer, color as indicated on drawings.

C. PANEL CONSTRUCTION:

1. Corner block type with 3/16" steel backup plate construction, mechanically secured with minimum of four hardened steel screws. Sash consists of snap-in glass stops, snap-in glazing beads and vinyl gaskets.

2. Weatherstripping material captured in extruded aluminum door panel. Door nosing weatherstrip to be spring-loaded adjustable astragal type. Surface applied self-adhesive weatherstripping not acceptable.

3. Slide-swing doors to be supplied with adjustable glass setting block to allow for adjusting of door to meet site conditions eliminating the need for additional shims.

D. FRAME CONSTRUCTION: Butt joints, mechanically secured by means of screws and formed aluminum corner brackets.

E. OPERATOR CONSTRUCTION: Electromechanical, modular type construction.

PART 3 EXECUTION

3.1 EXAMINATION

SITE VERIFICATION OF CONDITIONS: Installer must verify that base conditions previously installed under other sections are acceptable for product installation according to with manufacturer's instructions. Notify the Contractor in writing of conditions detrimental to the proper and timely completion of work. Do not start work until all negative conditions are corrected in a manner acceptable to the installer and manufacturer.

3.2 INSTALLATION

A. GENERAL: Install door units plumb, level and true to line, without warp or rack of frames or sash with manufacturer's prescribed tolerances. Provide support and anchor in place.

B. DISSIMILAR MATERIALS: Comply with AAMA 101, Appendix Dissimilar Materials by separating aluminum materials and other corrodible surfaces from sources of corrosion or electrolytic action contact points.

C. WEATHER-TIGHT CONSTRUCTION: Install header and framing members in a bed of sealant or with joint filler or gaskets. Coordinate installation with wall flashings and other components of construction.

D. ELECTRICAL: General or electrical contractor to install all wiring to operator on a separate circuit breaker routed into header.

3.3 CLEANING, ADJUSTMENT AND PROTECTION

A. CLEANING: After installation, installer to take following steps:

1. Remove temporary coverings and protection of adjacent work areas.

2. Remove construction debris from construction site and legally dispose of debris.

3. Repair or replace damaged installed products.

4. Clean product surfaces and lubricate operating equipment for optimum condition and safety.

B. ADJUSTMENT: AAADM certified technician shall inspect and adjust installation to assure compliance with ANSI A156.10.

C. ADVISE CONTRACTOR: Of precautions required through the remainder of the construction period, to ensure that doors will be without damage or deterioration at the time of acceptance.

-- End of Section --

SECTION 08520

ALUMINUM WINDOWS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101	(1997) Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors
AAMA 701	(1992) Voluntary Specification for Pile Weather Strip
AAMA 902	(1992) Voluntary Specification for Sash Balances
AAMA WSG.1	(1995) Window Selection Guide

ASTM INTERNATIONAL (ASTM)

ASTM B 221/B 221M	(2004a) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 584	(2004) Copper Alloy Sand Castings for General Applications
ASTM C 920	(2002)Elastomeric Joint Sealants

STEEL WINDOW INSTITUTE (SWI)

SWI-SWS	(1990) Steel Windows Specifications

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 12	(1982) Paint Specification No. 12 Cold-Applied Asphalt Mastic (Extra Thick Film)

1.2 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings for aluminum window units shall be submitted in accordance with paragraph entitled, "Drawings," of this section.

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items, including operating hardware, locking assemblies and strikes, and weatherstripping.

Hung Windows
Thermal-Barrier Windows
Mullions

Location(s) of product manufacture and of harvest/ extraction/ recovery of primary materials used in product.

1.3 DELIVERY, HANDLING, AND STORAGE

Windows, mullions, accessories, and trim shall be delivered in the manufacturer's unbroken containers and shall be handled carefully at all times to prevent damage.

Windows shall be stored on edge above ground and protected from the weather in accordance with the manufacturer's directions.

1.4 FIELD MEASUREMENTS

Field measurements shall be taken prior to preparation of the drawings and fabrication.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Wind Loading Design Pressure

Window components, including mullions, hardware, and anchors, shall be designed to withstand a wind-loading design pressure of at least 30 pounds per square foot (psf).

1.5.2 Tests

Windows proposed for use shall be tested in accordance with AAMA 101 for the particular type and quality window specified.

Tests shall be performed by a nationally recognized independent testing laboratory equipped and capable of performing the required tests. Results of the tests shall be submitted as certified laboratory reports required herein.

Minimum design load for a uniform-load structural test shall be 50 psf.

Hung windows shall be tested in accordance with the applicable portions of the AAMA WSG.1 for air infiltration, water resistance, uniform-load deflection, and uniform-load structural test.

1.6 DRAWINGS

Fabrication Drawings for aluminum window units shall be submitted showing complete window assembly including hardware, weatherstripping, and subframe assembly details.

PART 2 PRODUCTS

2.1 HUNG WINDOWS

Windows shall be the high-performance classification double-hung type meeting or exceeding AAMA 101 for Type H-AW45 and the requirements specified, complete with accessories, fittings, and trim.

Windows, mullions, hardware, and anchors shall be designed to withstand the wind loading specified.

Give preference to products manufactured and of primary raw materials harvested/ extracted/ recovered within a 500-mile radius of the Project Site.

2.1.1 Window Materials

Window Frames and sash members, mullions, mullion covers, screen frames, and glazing beads shall be extruded aluminum shapes fabricated from aluminum conforming to ASTM B 221/B 221M, 6063-T5 aluminum alloy.

Joint-sealing compound shall be a gun grade, nonsag, single-component butyl or acrylic sealant conforming to ASTM C 920.

Weatherstripping shall be woven wool pile weatherstripping 0.210 inch thick, conforming to AAMA 701, or polypropylene multifilament fiber weatherstripping installed in an integral weatherstripping groove in the sash or frame, and flexible polyvinylchloride weatherstripping installed in the sill member.

2.1.2 Window Construction

Frames, sash, and head members shall have a minimum thickness of 0.062 inch. Sills shall have a minimum thickness of 0.093 inch, and have weep holes not more than 2 feet on center.

Frame construction, including operable sash, shall be factory-assembled and factory-sealed inner and outer aluminum completely separated from metal-to-metal contact. Assembly shall be joined by a continuous, concealed, low conductance divider housed in an interlocking extrusion of the inner frame. Metal fasteners, straps, or anchors shall not bridge the connection between the inner and outer frame.

Horizontal sash members, muntins, and meeting rails shall be fabricated of extruded tubular-aluminum sections. Minimum depth of horizontal sash members and meeting rails shall be 1-1/16 inches. Sash lift shall be the full width of the window, extruded as an integral part of the sash.

Frames shall have a minimum depth of 3 inches and shall be provided with integral stiffening ribs, fins, drip at head, and weatherstripping grooves.

Frame and sash members shall be mechanically joined or welded to form rigid flush watertight joints. Joints shall be hairline not exceeding 1/64 inch and shall be sealed with factory-applied joint compound where required to provide a watertight joint.

Expansion between component parts of the window shall be provided to preclude absorption of thermal stresses in each unit.

Sash shall be completely separated from metal-to-metal contact by means of woven-pile weatherstripping, plastic, or elastomeric separation members.

2.1.3 Hardware for Hung Windows

Locking hardware shall be nickel-silver castings conforming to ASTM B 584, Alloy C97600, or AISI Series 300, 18-8 corrosion-resistant steel, or a combination of the two, furnished in contemporary design, smoothly finished, free of defects, and suitable for the intended purpose.

Sash lifts shall be continuous extrusions, integral with sash frames. Upper sashes shall have matching continuous-extrusion pulls.

Hung windows shall be provided with at least one lock and keeper. Windows over 3 feet wide shall be fitted with two locks and keepers.

Each sash shall operate on two adjustable, replaceable spring or spiral balances meeting the requirements of AAMA 902. Balances shall be enclosed in aluminum cases and shall be adjustable without removal of the sash from the frame and without the use of special tools.

2.1.4 Glazing Requirements

Windows shall be factory glazed but, designed for field-applied outside glazing, using snap-on, screwless, extruded-aluminum beads. Width of the stop bead shall be as required for glass thickness.

2.1.5 Weatherstripping Materials

Double weatherstripping shall be installed in jambs, meeting rails, sills, and heads of all windows.

2.2 FINISH

Aluminum window, mullions, glazing beadings, trim, and accessory fittings shall be thoroughly cleaned and shall receive high performance finish in accordance with AAM4 2604 with total dry film thickness of not less than 1.2 miles. The finish color shall be as indicated on the drawings.

PART 3 EXECUTION

3.1 INSTALLATION

Windows shall be set plumb, level to a tolerance of not more than 1/16 inch and in alignment without frame distortion and securely anchored in place as indicated, in accordance with the manufacturer's printed instructions and the approved drawings.

Fasteners shall be concealed except for specifically indicated mullion covers, window-operating hardware, screen attachment hardware, and similar surface-applied trim.

Ventilators and operating parts shall be protected against cement, lime, plaster, adhesives, and other building material after installation and until completion.

Fasteners, clips, fittings, aluminum trim, closures, and shapes shall be provided as indicated and as required to provide a complete installation.

Joints shall be sealed between sash units, aluminum sills, mullions, and covers and similar metal-to-metal contact surfaces with sealant or tape as recommended and furnished by the window manufacturer. Installations shall be weathertight.

Joint sealing between metal and masonry is specified in Section 07920S JOINT SEALANTS.

3.2 DISSIMILAR MATERIALS

Aluminum shall be kept from direct contact with steel or other dissimilar materials by painting, nonabsorptive tape, gasket, or other approved system as recommended by the manufacturer and as specified.

Aluminum surfaces placed in contact with wood, concrete, or masonry construction shall be given one coat of bituminous paint conforming to SSPC Paint 12, applied to a thickness of at least 1/16 inch.

3.3 ADJUSTMENT AFTER INSTALLATION

After the sash is erected and glazed, ventilators shall be lubricated and adjusted for smooth weathertight operation. Guides shall be waxed or lubricated and balances shall be adjusted for the proper tension.

Weatherstripping shall make weathertight contact around the entire weatherstripped area when ventilators are closed and locked. Weatherstripping shall not cause the sash to bind or prevent closing and locking the ventilator.

3.4 FEELER-GAGE FIELD TEST

Windows shall be tested after installation, glazing, and adjustment for metal-to-metal contact between ventilators and frames by feeler-gage tests in accordance with SWI-SWS.

Windows failing to meet the requirements of the feeler-gage tests shall be corrected as required to meet the tests. Such windows shall be retested and, if they fail the tests again, shall be removed and replaced.

3.5 CLEANING AFTER INSTALLATION

Interior and exterior metal surfaces of windows shall be cleaned of mortar, plaster, paint spattering or spots, and other foreign matter, and washed with soap and water, brushed with a fiber brush, and thoroughly rinsed with clear water. Acid solutions, steel wool, or other harsh abrasives shall not be used.

Stained or discolored windows shall be cleaned in accordance with the window manufacturer's recommendations. Windows that cannot be satisfactorily cleaned and windows with abraded, stained, or defective surface finish that cannot be satisfactorily repaired shall be replaced.

-- End of Section --

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E 283	(1991; R 1999) Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1	(2000) Butts and Hinges
BHMA A156.2	(2003) Bored and Preassembled Locks and Latches
BHMA A156.3	(2001) Exit Devices
BHMA A156.4	(2000) Door Controls - Closers
BHMA A156.5	(2001) Auxiliary Locks & Associated Products (BHMA 501)
BHMA A156.6	(2001) Architectural Door Trim
BHMA A156.7	(2003) Template Hinge Dimensions
BHMA A156.8	(2000) Door Controls - Overhead Stops and Holders
BHMA A156.13	(2002) Locks & Latches - Mortise (BHMA 621)
BHMA A156.15	(2001) Closer Holder Release Device
BHMA A156.16	(2002) Auxiliary Hardware
BHMA A156.18	(2003) Materials and Finishes
BHMA A156.21	(2001) Thresholds
BHMA A156.22	(2003) Door Gasketing Systems

STEEL DOOR INSTITUTE (SDI)

ANSI A250.8	(1998) SDI-100 Recommended Specifications for Standard Steel Doors and Frames

1.2 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Hardware schedule

Keying system

SD-03 Product Data

Hardware items

SD-10 Operation and Maintenance Data

Hardware Schedule items

Submit data in accordance with Section 01781 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Key Bitting

1.3 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (If fire rated and listed)	BHMA Finish Designation

1.4 KEY BITTING CHART REQUIREMENTS

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

a. Complete listing of all keys (AA1, AA2, etc.).

b. Complete listing of all key cuts (AA1-123456, AA2-123458).

c. Tabulation showing which key fits which door.

d. Copy of floor plan showing doors and door numbers.

e. Listing of 20 percent more key cuts than are presently required in each master system.

1.5 QUALITY ASSURANCE

1.5.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys and removable cores to the Owner, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Provide hardware to be applied to metal manufactured to template. Promptly furnish template information or templates to door and frame manufacturers. Conform to BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE ITEMS

Clearly and permanently mark with the manufacturer's name or trademark, hinges, pivots, locks, latches, exit devices, bolts and closers where the identifying mark will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

2.2.1 Hinges

BHMA A156.1, 4-1/2 by 4-1/2 inch unless otherwise indicated. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed.

2.2.2 Locks and Latches

2.2.2.1 Bored Locks and Latches

BHMA A156.2, Series 4000, Grade 1.

2.2.2.2 Auxiliary Locks

BHMA A156.5, Grade 1.

2.2.3 Exit Devices

BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Provide touch bars in lieu of conventional crossbars and arms.

2.2.4 Electronic Locks

Electronic locks shall be heavy duty type with digital keypad. Keypad shall be battery operated with an expected battery life of 80,000 operations. Electronic locks shall be equipped with lever trim and shall have a key backup. Lock cylinder shall have a removable core compatible with the building keying system.

2.2.5 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under

other sections of this specification. Provide cylinders and cores with seven pin tumblers. Provide cylinders from products of one manufacturer, and provide cores from the products of one manufacturer. Rim cylinders and knobs of bored locksets have interchangeable cores which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.

2.2.6 Keying System

Provide a master keying system. Provide construction interchangeable cores.

2.2.7 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.2.7.1 Levers and Roses

Conform to the minimum test requirements of BHMA A156.2 and BHMA A156.13 for levers, roses, and escutcheons. For unreinforced levers, roses, and escutcheons, provide 0.050 inch thickness. For reinforced levers, roses, and escutcheons, provide outer shell of 0.035 inch thickness, and combined thickness of 0.070 inch.

Conform to the minimum requirements of BHMA A156.13 for mortise locks of lever handles for exit devices. Provide lever handle locks with a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when force in excess of that specified in BHMA A156.13 is applied to the lever handle. Provide lever handles that return to within 1/2 inch of the door face. Door Lever design shall be "Omega" by Schlage or approved equal.

2.2.8 Keys

Furnish one file key, one duplicate key, and one working key for each key change and for each master keying system. Furnish one additional working key for each lock of each keyed-alike group. Furnish control keys for removable cores. Furnish a quantity of key blanks equal to 20 percent of the total number of file keys. Stamp each key with appropriate key control symbol.

2.2.9 Door Bolts

BHMA A156.16. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds. Manual latching flush bolts: BHMA A156.16.

2.2.10 Closers

BHMA A156.4, Series C02000, Grade 1, with fuctions as indicated on drawings. Provide with brackets, arms, mounting devices, fasteners, full size covers, except at storefront mounting, and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations. Provide manufacturer's 10 year warranty.

2.2.10.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.

2.2.11 Overhead Holders

BHMA A156.8.

2.2.12 Closer Holder-Release Devices

BHMA A156.15.

2.2.13 Pulls and Push Bars

BHMA A156.6. Provide decorative exterior cast pull similar to Rockwood #RM5512. Push bar shall be as indicated on hardware schedule.

2.2.14 Door Protection Plates

BHMA A156.6.

2.2.14.1 Sizes of Kick Plates

2 inch less than door width for single doors; one inch less than door width for pairs of doors. Provide 10 inch kick plates.

2.2.15 Door Stops and Silencers

BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair, unless gaskets or weatherstripping are specified.

2.2.16 Thresholds

BHMA A156.21.

2.2.17 Weather Stripping

BHMA A156.22. Provide the type and function designation where specified in the "Hardware Schedule". Provide a set to include head and jamb seals and, for pairs of doors, astragals. Air leakage of weather stripped doors not to exceed 0.5 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E 283. Provide weather stripping with one of the following:

2.2.17.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 0.050 inch wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Provide clear (natural) anodized aluminum.

2.2.18 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.3 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Provide stainless steel or nonferrous metal fasteners that are exposed to weather. Provide fasteners of type necessary to accomplish a permanent installation.

2.4 FINISHES

BHMA A156.18. Provide hardware in BHMA 630 finish (satin stainless steel), unless specified otherwise. Match exposed parts of concealed closers to lock and door trim.

2.5 KEY CABINET AND CONTROL SYSTEM

BHMA A156.5, Type required to yield a capacity (number of hooks) 50 percent greater than the number of key changes used for door locks.

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed installation instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Weather Stripping Installation

Handle and install weather stripping to prevent damage. Provide full contact, weather-tight seals. Operate doors without binding.

3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 9 inch on center after doors and frames have been finish painted.

3.1.2 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

3.2 HARDWARE LOCATIONS

ANSI A250.8, unless indicated or specified otherwise.

a. Kick Plates: Push side of doors.

3.3 KEY CABINET AND CONTROL SYSTEM

Locate where directed. Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key. Furnish complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand master key.

3.4 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other

items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.5 HARDWARE SETS

See Hardware groups listed on drawings. Provide hardware for aluminum doors under this section. Deliver Hardware templates and hardware, except field-applied hardware to the aluminum door and frame manufacturer for use in fabricating the doors and frames.

-- End of Section --

SECTION 08805

GLASS AND GLAZING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 800	(1992) Voluntary Specifications and Test Methods for Sealants

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(1984; R 1994) Safety Glazing Materials Used in Buildings

ASTM INTERNATIONAL (ASTM)

ASTM C 1036	(2001) Standard Specification for Flat Glass

FLAT GLASS MARKETING ASSOCIATION (FGMA)

FGMA-01	(2001) Glazing Manual

1.2 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-04 Samples

Contractor shall submit the following samples:

Not less than 2 different samples 10 by 12 inches of each glass of the specified type, class, thickness, and finish shall be provide for inspection and approval by the Architect prior to delivery of material to site.

SD-07 Certificates

Certificates shall be submitted for the following items showing conformance with the referenced standards and tests contained in this section.

Glass Materials
Glazing Materials
Safety Rated Tempered Glass

1.3 DELIVERY, STORAGE AND HANDLING

Manufactured glass units shall be delivered and stored until installation

in the manufacturer's container's and shall be clearly marked on the exterior as to type, and quantity of units.

When special moisture protection is required, glass shall be stored in accordance with the manufacturer's recommendations.

PART 2 PRODUCTS

2.1 GLASS MATERIALS

2.1.1 Clear Glass

Glass shall be float type conforming to ASTM C 1036, Type I, Class 1, Quality q3.

Maximum allowable areas of glass subject to wind pressure shall conform to the glass manufacturer's recommendations.

2.1.2 Spandrel Glass

Glass shall be float type conforming to ASTM C 1036, Type I, Quality q3, heat strengthened or fully tempered with opaque coating on the # 2 surface. Edges shall be factory or shop clean-cut.

Color shall be black.

Maximum allowable areas of glass subject to wind pressure shall conform to the glass manufacturer's recommendations.

2.1.3 Safety-Rated Tempered Glass

Glass shall conform to ANSI Z97.1 and shall bear the ANSI safety glass marking.

Glass before tempering shall be the float type conforming to ASTM C 1036, Type I, Class I, Quality q3.

Glass shall be factory-cut to suit each opening. Edges shall be clean cut.

2.1.4 Double-Glazing Units

Units shall be factory fabricated, shall be two panels of flat glass separated by a hermetically sealed, dehydrated air space, with a low-e coating on the # 2 surface.

Maximum allowable areas of glass subject to wind pressure shall conform to the glass manufacturer's recommendations.

Provide tempered glass in double-glazed units to be installed in or adjacent to doors, and as indicated on the drawings.

Clear double-glazing units shall be as follows:

OUTER PANE GLASS, THICKNESS	INNER PANE GLASS, THICKNESS	AIR SPACE WIDTH	EDGE SEAL
Clear float 1/4 inch thick	Same as outer pane	1/2 inch	Glass

2.2 GLAZING MATERIALS

2.2.1 Glazing Tape

Tape shall be nonskinning, nonoily, reinforced class, butyl- or polyisobutylene-base resilient preformed compound conforming to AAMA 800.

2.2.2 Solvents and Cleaning Agents

Solvents, cleaning agents, and other cleaning materials shall be as recommended by the glazing-material manufacturer.

2.2.3 Glazing Clips

Clips shall be zinc-coated or copper-clad spring-steel wire or nonferrous metal and shall be the type, sizes, and shapes suitable for the intended use.

2.2.4 Resilient Setting Blocks and Spacers

Blocks shall be solid chloroprene elastomeric extrusions having a Shore A durometer hardness between 70 and 90. Thickness shall be approximately the same as the glass-edge clearance dimension; the length shall be 4 inches, minimum.

Spacers shall be solid chloroprene elastomeric extrusions having a Shore A durometer hardness between 40 and 50. Spacers shall be 2- to 3-inches long with thickness and height to suit the application.

PART 3 EXECUTION

3.1 GENERAL

Glass shall be installed in accordance with the manufacturer's printed instructions.

Field cutting, or nipping or grinding the edges of glass will not be permitted.

Sheet glass shall be installed with the wave horizontal.

Sizes of glass shown on drawings are approximate. Sizes and proper edge clearances shall be determined by measuring the actual unit to receive glass. Except where specified otherwise, each piece of glass shall bear the manufacturer's label to identify its type as well as thickness and quality. Labels shall not be removed until final approval is obtained.

3.2 GLASS IN ALUMINUM DOOR AND WINDOW UNITS

Glazing units shall be factory-glazed in aluminum door and window units with the manufacturer's preformed glazing gaskets and installed in accordance with the manufacturer's printed instructions.

3.3 TEMPERATURE AND ATMOSPHERIC CONDITIONS

Glazing materials shall not be installed when the ambient temperature is below 40 or above 100 degrees F.

Exterior glazing shall not be performed in damp or rainy weather.

3.4 GLAZED OPENINGS PREPARATION

Surface of rabbets shall be clean and dry prior to the start of glazing.

Surfaces in contact with glazing materials shall be clean and free of loose particles, surface dust, and other foreign matter.

3.5 CLEARANCES AND POSITIONING GLASS

Face and edge clearances and positioning glass with setting blocks and spacers shall be as recommended in the FGMA-01.

3.6 APPLICATION OF GLAZING COMPOUNDS

Glazing compounds shall be installed in accordance with the manufacturer's printed instructions and as follows:

Glazing tape shall be compressed slightly to obtain a positive bond and neatly mitered or butted at corners. Backing paper shall be removed prior to installation of the glass.

3.7 GLASS IN METAL SASH WITH CHANNEL GLAZING

Glass units shall be set with glazing-tape back bed, thermoplastic sealing-compound heel bead, glazing-tape bedding of stop, and thermoplastic sealing-compound topping bead on both sides of the glass light. Glazing tape shall be kept down at least 1/8-inch below the sight line.

Excess sealing compound on the sash shall be removed with a glazing knife at a slight angle over the sight line.

3.8 GLASS PROTECTION

Glazed openings shall be identified during the construction period by tapes or flags that are not in contact with the glass.

Temporary labels shall be removed immediately after the glass and glazing work has been approved.

3.9 CLEANING

Upon completion of work, glass surfaces shall be cleaned and shall be free of glazing- or sealing-compound, smears, and other defacement.

-- End of Section --

SECTION 09250

GYPSUM BOARD

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.11	(1992) Interior Installation of Cementitious Backer Units

ASTM INTERNATIONAL (ASTM)

ASTM C 36/C 36M	(2001) Gypsum Wallboard
ASTM C 635	(2000) Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 79/C 79M	(2001) Standard Specification for Treated Core and Nontreated Core Gypsum Sheathing Board
ASTM C 442/C 442M	(2001) Gypsum Backing Board, Gypsum Coreboard, and Gypsum Shaftliner Board
ASTM C 475	(2001) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 840	(2001) Application and Finishing of Gypsum Board
ASTM C 954	(2000) Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
ASTM C 1002	(2001) Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
ASTM C 1047	(1999) Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C 1396/C 1396M	(2003a) Standard Specification for Gypsum Board

GYPSUM ASSOCIATION (GA)

GA 214	(1996) Recommended Levels of Gypsum Board Finish
GA 216	(2000) Application and Finishing of Gypsum Board
GA 600	(2003) Fire Resistance and Sound Control Design Manual

UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(2004) Fire Resistance Directory

1.2 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Accessories

Submit for each type of gypsum board.

Gypsum Board - Location(s) of product manufacture and of harvest/ extraction/ recovery of primary materials used in product. Designation of the percentages of post-consumer and pre-consumer recycled-content in gypsum materials.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Provide adequate ventilation to prevent condensation.

1.3.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

1.4 ENVIRONMENTAL CONDITIONS

1.4.1 Temperature

Maintain a uniform temperature of not less than 50 degrees F in the structure for at least 48 hours prior to, during, and following the application of gypsum board, cementitious backer units, and joint treatment materials, or the bonding of adhesives.

1.4.2 Exposure to Weather

Protect gypsum board and cementitious backer unit products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

1.5 QUALIFICATIONS

Furnish type of gypsum board work specialized by the installer with a minimum of 5 years of documented successful experience.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to specifications, standards and requirements specified. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only.

Provide gypsum board containing 100% recovered flue-gas gypsum (synthetic gypsum) content manufactured and of primary materials recovered within 500 miles of Project Site.

2.1.1 Gypsum Board

ASTM C 36/C 36M and ASTM C 1396/C 1396M.

2.1.1.1 Regular

48 inch wide,5/8 inch thick, tapered edges.

2.1.1.2 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, tapered edges.

2.1.2 Reinforced Gypsum Sheathing

Exceeds physical properties of ASTM C 79/C 79M. Provide 5/8 inch, gypsum sheathing. Provide gypsum board with a fire and moisture-resistant core, with moisture resistant face paper on both sides and long edges .

2.1.3 Joint Treatment Materials

ASTM C 475.

2.1.3.1 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.3.2 Joint Tape

Cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.4 Fasteners

2.1.4.1 Screws

ASTM C 1002, Type "G", Type "S" or Type "W" steel drill screws for

fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.033 inch thick. ASTM C 954 steel drill screws for fastening gypsum board to steel framing members 0.033 to 0.112 inch thick. Provide cementitious backer unit screws with a polymer coating.

2.1.5 Shaftwall Liner Panel

ASTM C 442/C 442M. Conform to the UL Fire Resist Dir for the Design Numbers(s) indicated for shaftwall liner panels. Manufacture liner panel for cavity shaftwall system, with water-resistant paper faces, bevel edges, single lengths to fit required conditions, 1" thick, by 24" wide.

2.1.6 Drywall Suspension System

Drywall Suspension System shall conform to ASTM C 635 for intermediate-duty systems as specified in Section 09510 - "ACOUSTICAL CEILINGS". Drywall Suspension Systems shall have 1 1/2 tees and wall angles.

2.1.7 Accessories

ASTM C 1047. Fabricate from corrosion protected steel or plastic designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges shall be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished or job decorated materials.

2.1.8 Water

Provide clean, fresh, and potable water.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board units. Do not proceed with work until framing and furring are acceptable for application of gypsum board.

3.1.2 Drywall Suspension System

Install Drywall Suspension System as specified in Section 09510 "ACOUSTICAL CEILINGS".

3.2 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing, furring members and suspension system in accordance with ASTM C 840 or GA 216 and the requirements specified. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length. Cut out gypsum board to make neat, close, and tight joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Provide type of gypsum board for use in each system specified herein as

indicated.

Coordinate installation with requirements of Division 1 Section "Construction Indoor Air Quality Management."

3.2.1 Application of Single-Ply Gypsum Board to Wood Framing

Apply in accordance with ASTM C 840, System I or GA 216.

3.2.2 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C 840, System VIII or GA 216.

3.2.3 Exterior Application

Apply exterior gypsum sheathing (such as at soffits) in accordance with ASTM C 840, System XI or GA 216.

3.3 Joint Treatment

ANSI A108.11.

3.4 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C 840, GA 214 and GA 216. Finish plenum areas above ceilings to Level 1 in accordance with GA 214. Finish all exposed gypsum board surfaces to Level 5 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Do not use fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only.

3.4.1 Uniform Surface

Wherever gypsum board is to receive eggshell, semigloss or gloss paint finish, or where severe, up or down lighting conditions occur, finish gypsum wall surface in accordance to GA 214 Level 5. In accordance with GA 214 Level 5, apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.

3.5 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07920S JOINT SEALANTS Apply material with exposed surface flush with gypsum board or cementitious backer units.

3.6 FIRE-RESISTANT ASSEMBLIES

Wherever fire-rated construction is indicated, provide materials and application methods, including types and spacing of fasteners, wall, and ceiling framing in accordance with the specifications contained in UL Fire Resist Dir for the Design Number(s) indicated, or GA 600 for the File Number(s) indicated. Joints of fire-rated gypsum board enclosures shall be closed and sealed in accordance with UL test requirements or GA requirements. Seal penetrations through rated partitions and ceilings tight in accordance with tested systems.

3.7 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes.

3.8 SHAFTWALL FRAMING

Install the shaftwall system in accordance with the system manufacturer's published instructions. Coordinate bucks, anchors, blocking and other items placed in or behind shaftwall framing with electrical and mechanical work. Patch or replace fireproofing materials which are damaged or removed during shaftwall construction.

3.9 CONSTRUCTION WASTE MANAGEMENT

Recycle clean unpainted gypsum board products with requirements of Division 1 Section "Construction Waste Management."

-- End of Section --

SECTION 09445

RESINOUS TERRAZZO FLOORING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 56 (2001)Flash Point by Tag Closed Cup Tester

NATIONAL TERRAZZO & MOSAIC ASSOCIATION (NTMA)

NTMA Info Guide (2000) Terrazzo Information Guide

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings
Strips
Control Joint Strips

Drawings indicating the type, size, and layout of divider strips and control joint strips.

SD-03 Product Data

Resin
Mixing, Proportioning, and Installation
Cleaning and Sealing

Resin manufacturer's descriptive data, mixing, proportioning, and installation instructions. Maintenance literature for terrazzo cleaning and sealing shall be included.

MSDS of all field applied floor sealers used within the building interior, highlighting VOC content.

Resinous Terrazzo Flooring

Designation of the percentages of post-consumer and pre-consumer recycled-content in flooring materials.

SD-04 Samples

Resinous Terrazzo Flooring

Two 6 x 6 inches, (minimum) samples of each color of resinous terrazzo and two 6 inches lengths, of each type of strip.

SD-07 Certificates

Conductive Resinous Terrazzo Flooring

Certificates indicating conformance with specified requirements. Certificates shall be accompanied by certified test reports showing that the conductive resinous terrazzo floor has been tested and meets the requirements specified.

1.3 GENERAL REQUIREMENTS

Resinous terrazzo flooring, in the colors indicated, shall be applied in the areas shown on the approved detail drawings. Flooring shall be an epoxy terrazzo system that conforms to the requirements specified in paragraphs 2.01A and B of NTMA Info Guide.

1.4 QUALIFICATION OF APPLICATOR

Applicator shall be approved by the resin manufacturer and shall have a minimum of 3 years experience in the application of the materials to be used and shall have completed 8 successful installations within the past 2 years.

1.5 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers. Materials shall be kept in a clean, dry, area with temperatures controlled between 50 and 90 degrees F.

1.6 ENVIRONMENTAL REQUIREMENTS

Areas to receive terrazzo shall be maintained at a temperature above 50 degrees F for 2 days prior to installation and for 7 days following installation.

PART 2 PRODUCTS

2.1 PRIMER

Primer shall be a material recommended by the resin manufacturer which will penetrate the pores of the substrate and bond with the topping to form a permanent monolithic bond between the substrate and the topping.

2.2 RESIN

Resin for the specified terrazzo flooring shall conform to the requirements shown in NTMA Info Guide.

2.3 FILLERS

Fillers, if required, shall be inert mineral or cellulosic material as recommended by the manufacturer and best suited for the resin binder used. Fillers shall be furnished in the quantity necessary to impart the required color and physical characteristics.

2.4 AGGREGATE

Aggregate shall be of 100% post-consumer recycled glass of sizes and colors to match color indicated on the drawings. Chips shall be a range of sizes up to and including the NTMA Standard No. 0 and Standard No. 1 for 1/4 inch thick floors and Standard No. 0 through Standard No. 2 for 3/8 inch thick floors.

2.5 STRIPS

2.5.1 Divider Strips

Divider strips shall be as deep as required, 16 gauge and of zinc.

2.6 GROUT

Grout shall be as recommended by the manufacturer of the resin.

2.7 SEALER

Sealer shall have a pH factor between 7 and 10 and shall be a penetrating type specially prepared for use on terrazzo. The sealer shall not discolor or amber the terrazzo and shall produce a slip resistant surface. Flash point of sealer shall be a minimum of 80 degrees F when tested in accordance with ASTM D 56.

Sealer shall have a VOC content not more than 200 g/l.

PART 3 EXECUTION

3.1 PREPARATION OF CONCRETE SUBFLOOR

Installation of the floor topping shall not commence until the concrete substrate is at least 28 days old. The concrete surfaces shall be prepared in accordance with the instructions of the resin manufacturer.

Coordinate installation with requirements of Division 1 Section "Construction Indoor Air Quality Management."

3.2 MIXING, PROPORTIONING, AND INSTALLATION

Mixing, proportioning, and installing shall be in accordance with the approved instructions of the manufacturer. Strips shall be installed in locations indicated. The topping shall be applied to give a finish thickness of 1/4 inch.

3.3 CLEANING AND SEALING

The terrazzo shall be washed with a neutral cleaner and where required shall be cleaned with a fine abrasive to remove any stains or cement smears. The cleaned surfaces shall be rinsed. When dry, a terrazzo sealer shall be applied in accordance with the manufacturer's directions.

3.4 PROTECTION

The terrazzo work shall be covered and protected from damage until completion of the work of all other trades.

-- End of Section --

SECTION 09510

ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 489	(2004) Carbon Steel Lifting Eyes
ASTM A 641/A 641M	(1998) Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM C 635	(2000) Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636	(1996) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E 1264	(1998) Acoustical Ceiling Products

1.2 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Acoustical Ceiling Systems

Manufacturer's data shall be submitted in accordance with LEED Certification requirements indicating percentage of recycle material in acoustic ceiling tiles to verify compliance.

Total weight and volume quantities of acoustic ceiling tiles with recycle material shall be submitted.

Location(s) of product manufacture and of harvest/ extraction/ recovery of primary materials used in product.

Caulk

MSDS of all caulk used within the building interior, highlighting VOC content.

SD-04 Samples

Acoustical Units

Two samples of each type of acoustical unit and each type of

suspension grid tee section showing texture, finish, and color.

1.3 DELIVERY AND STORAGE

Materials must be delivered to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Materials mustbe carefully handled and stored in dry, watertight enclosures. Immediately before installation, acoustical units shall be stored for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.4 ENVIRONMENTAL REQUIREMENTS

Maintain a uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent for 24 hours before, during, and 24 hours after installation of acoustical units.

1.5 SCHEDULING

Interior finish work such as plastering, concrete and terrazzo work must be complete and dry before installation. Mechanical, electrical, and other work above the ceiling line must be completed and heating, ventilating, and air conditioning systems must be installed and operating in order to maintain temperature and humidity requirements.

1.6 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period. Standard performance guarantee or warranty must contain an agreement to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of grid system.

1.7 EXTRA MATERIALS

One box of spare tiles shall be provided to the owner.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

Contractor shall comply with LEED requirements. Acoustical units shall conform to ASTM E 1264, Class A, and the following requirements:

Provide acoustical ceiling panels manufactured and of primary materials recovered within 500 miles of Project Site.

2.1.1 RECYCLED CONTENT

Contractor shall submit recycled material content data for acoustic ceiling tiles indicating compliance with LEED Certification requirements.

Contractor shall submit total weight and volume quantities of acoustic ceiling tiles with recycle material.

2.1.2 Units for Exposed-Grid System

a. Type: III (non-asbestos mineral fiber with painted finish).

b. Flame Spread: Class A, 25 or less

c. Pattern: Fine-fissured.

d. Minimum NRC: 0.50.

e. Minimum Light Reflectance Coefficient: LR-1, 0.75 or greater.

f. Nominal size: 24 by 24 inch.

g. Edge detail: Square.

h. Finish: Factory-applied standard finish.

i. Minimum CAC: 40.

2.2 SUSPENSION SYSTEM

Suspension system shall be standard exposed-grid standard width flange, and must conform to ASTM C 635 for intermediate-duty systems. Surfaces exposed to view must be aluminum or steel with a factory-applied white baked-enamel finish.

Wall molding must have a flange of not less than 23 mm 15/16 inch. Mitered corners shall be provided. Suspended ceiling framing system musthave the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. The suspension system must have a maximum deflection of 1/360 of span length.

Suspension system shall have a minimum recycled content of 25 percent.

2.3 HANGERS

Hangers and attachment must support a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

2.3.1 Wires

Wires must conform to ASTM A 641/A 641M, Class 1, 12 ga.

2.3.2 Eyebolts

Provide eyebolts of weldless, forged-carbon-steel, with a straight-shank in accordance with ASTM A 489. Eyebolt size must be a minimum 1/4 inch zinc coated.

2.4 FINISHES

Acoustical units and suspension system members must have manufacturer's standard textures, patterns and finishes as specified. Ceiling suspension system components must be treated to inhibit corrosion.

2.5 COLORS AND PATTERNS

Colors and patterns for acoustical units and suspension system components

shall be as indicated on drawings.

PART 3 EXECUTION

3.1 Suspension System

Suspension system must be installed in accordance with ASTM C 636 and as specified herein.

3.1.1 Plumb Hangers

Hangers must be plumb and must not press against insulation covering ducts and pipes. Where lighting fixtures are supported from the suspended ceiling system, hangers must be provided at a minimum of four hangers per fixture and located not more than 6 inch from each corner of each fixture.

3.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, the resulting horizontal force shall be offset by bracing, countersplaying, or other acceptable means.

3.2 Wall Molding

Wall molding must be provided where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Wall molding must be secured not more than 3 inch from ends of each length and not more than 16 inch on centers between end fastenings. Wall molding springs must be provided at each acoustical unit in semi-exposed or concealed systems.

3.3 Acoustical Units

Acoustical units must be installed in accordance with the approved installation instructions of the manufacturer. Edges of acoustical units must be in close contact with metal supports, and in true alignment. Acoustical units must be arranged so that units less than one-half width are minimized.

3.4 Caulking

Seal all joints around pipes, ducts or electrical outlets penetrating the ceiling.

Caulk shall have a VOC content not more than 250 g/l.

3.5 CLEANING

Following installation, dirty or discolored surfaces of acoustical units must be cleaned and left free from defects. Units that are damaged or improperly installed must be removed and new units provided as directed.

-- End of Section --

SECTION 09670

TROWEL APPLIED EPOXY FLOORING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 307	(2003) Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings
ASTM C 579	(2001) Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
ASTM C 580	(2002) Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
ASTM D 1308	(2002e1) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 4060	(2001) Abrasion Resistance of Organic Coatings by the Taber Abraser

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sealer and Resin
Floor Surfacing

Flooring manufacturer's descriptive data, mixing, proportioning, and installation instructions. Maintenance literature for resinous flooring shall be included.

MSDS of floor sealer used within the building interior, highlighting VOC content.

SD-04 Samples

Flooring Systems

Cured samples of each floor finish or color combination.

SD-10 Operation and Maintenance Data

Flooring Systems

Operation and Maintence Data in accordance with Section 01781 OPERATION AND MAINTENANCE DATA.

1.3 DELIVERY AND STORAGE

Deliver the materials to the project site in unopened bags and containers clearly labeled with the name of the manufacturer, type of material, batch number, and date of manufacture. Store materials, other than aggregates, away from fire, sparks, or smoking areas. Maintain the storage area between 50 and 90 degrees F.

1.4 ENVIRONMENTAL CONDITIONS

Maintain the ambient room and floor temperatures at 65 degrees F, or above, for a period extending from 48 hours before installation until one week after installation. Concrete to receive surfacing shall have cured for at least 28 days and shall have been free of water for at least 7 days. Wood substrates shall have a measured moisture content of between 8 and 10 percent prior to application.

1.5 PROTECTION

Protect adjacent surfaces not scheduled to receive the flooring by masking, or by other means, to maintain these surfaces free of the flooring material.

1.6 QUALIFICATIONS OF INSTALLER

Installation shall be performed by an applicator approved by the manufacturer of the floor surfacing materials. The Contractor shall furnish a written statement from the manufacturer that the installer is acceptable.

PART 2 PRODUCTS

2.1 MATERIALS

Materials used in the flooring shall be the products of a single manufacturer. Industrial resin-based flooring shall be a monolithic trowel applied 1/4 inch thick, epoxy material with chemical resistance and moderate to heavy traffic resistance. Materials shall meet the following requirements:

2.1.1 Primer

Type recommended by the manufacturer to penetrate into the pores of the substrate and bond with the floor surfacing matrix to form a permanent monolithic bond between substrate and surfacing matrix.

2.1.2 Aggregate

Aggregate shall be selected from manufacturer's standard aggregates.

2.1.3 Binder

Binder shall be thermo-setting epoxy.

2.1.4 Fillers

Fillers, if required, shall be as recommended by the flooring manufacturer. Fillers shall be furnished in the quantity necessary to impart the required color and physical characteristics.

2.1.5 Top Coating

Furnish clear coating of type recommended by the manufacturer.

2.2 FLOORING SYSTEMS

The complete systems, after curing, shall have the following properties when tested in accordance with the test methods listed for each property.

2.2.1 Epoxy Matrix Floor Surfacing

a. Compressive Strength: ASTM C 579; 10,000 psi minimum at 7 days.

b. Tensile Strength: ASTM C 307; 1400 psi minimum at 7 days.

c. Flexural Strength: ASTM C 580; 4,000 psi minimum at 7 days.

d. Abrasion Resistance: ASTM D 4060; 0.04g maximum weight loss.

e. Chemical Resistance: ASTM D 1308; no effect when exposed to the following reagents for 7 days:

Acetic acid: 5 percent solution
Ammonium Hydroxide: 10 percent solution
Citric Acid: 5 percent solution
Coffee
Coca Cola Syrup
Isopropyl Alcohol
Mineral Oil
Sodium Hydroxide: 5 percent solution
Tri-Sodium Phosphate: 5 percent solution
Urea: 6.6 percent solution

2.3 SEALER

Sealer shall be a product recommended by the flooring manufacturer; when applied to the topping and dry, it shall be nonslip and resistant to staining.

Sealer shall have a VOC content not to exceed 200 g/l.

2.4 COLOR

Color shall be as indicated on the drawings.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Remove all dirt, dust, debris, and other loose particles by sweeping or vacuum cleaning.

3.1.1 Concrete Surfaces

3.1.1.1 Mechanical Cleaning

Completely remove dirt, wax, paint,and laitance, by grinding with a terrazzo machine, sanding with coarse open grid sandpaper, sand blasting, chipping, bush hammering, or wire brushing.

3.1.1.2 Steam Cleaning

Completely remove all animal fats, grease, oil, and wax using a high pressure steam cleaner equipped with a soap injection system. Scrape the surface to remove any build-up of debris. Then thoroughly saturate the surface with hot caustic solution. Allow the solution to remain on the floor for 15 to 20 minutes. Apply steam, with caustic, over the presoaked area until all contamination is removed. Leach the caustic residue from the surface using one or more applications of steam without caustic. Flush the floor with warm water.

3.1.1.3 Air Drying

After cleaning, allow concrete surface to air dry thoroughly prior to application of surfacing. Blowers or oil free compressed air may be used. Do not use flame-drying methods. Prior to application of surfacing, test concrete surface for excessive moisture in at least two locations. Place rubber mats at each location with smooth side against concrete and place weight on top of mat to hold in position and ensure contact with concrete. Polyethylene with all edges taped may be used in lieu of mats. After 8 hours remove mat or sheeting and examine floor surface for moisture accumulation. If tests indicate accumulation of moisture at either location, additional air drying shall be undertaken until additional tests show no moisture accumulation.

3.1.2 Filling Cracks, Spalls, Joints, and Other Depressions

Fill all cracks, joints, spalls, and other depressions in the substrate with a latex underlayment, as recommended by the manufacturer compatible with the floor surfacing material.

3.2 MIXING

Proportion and mix the floor surfacing components in accordance with the manufacturer's instructions.

3.3 APPLICATION

Apply primer, floor surfacing, and seal coat in accordance with the manufacturer's recommendations and the following requirements.

3.3.1 Primer

Apply primer uniformly over the entire area to receive floor surfacing

using clean rubber squeegees or clean steel trowels. Do not allow primer to collect in depressions. Allow primer to dry thoroughly before the next coat is applied. Reprime porous areas or areas where primer has dried.

3.3.2 Floor Surfacing

Apply mixed surfacing material to provide a finish floor surfacing not less than 1/8 inch thick. The entire surfacing in any one room or area shall be placed in one continuous operation without use of cold joints or divider strips. All surfaces shall be flush, true to plane and line, and level within 1/4 inch in 10 feet,except as required to slope to floor drains.

3.3.3 Seal Coat

Apply seal coat uniformly covering all surfaces after floor surfacing has cured and as recommended by the supplier.

3.4 PROTECTION

Surfacing shall set for a minimum period of 48 hours before traffic is allowed on the floor. Finished flooring shall be protected from traffic by covering with 30 pound building paper or other equally effective means until final acceptance of the project.

-- End of Section --

SECTION 09900

PAINTS AND COATINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100Doc	(2001) Documentation of the Threshold Limit Values and Biological Exposure Indices

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1	(1996) Scheme for Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM D 2092	(1995; R 2001e1) Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting
ASTM D 4263	(1983; R 1999) Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D 4444	(1992; R 2003) Use and Calibration of Hand-Held Moisture Meters
ASTM D 523	(1989; R 1999) Specular Gloss
ASTM F 1869	(2004) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

MASTER PAINTERS INSTITUTE (MPI)

MPI 101	(Jan 2004) Epoxy Anti-Corrosive Metal Primer
MPI 107	(Jan 2004) Rust Inhibitive Primer (Water-Based)
MPI 110	(Jan 2004) Water Based Light Industrial Coating, G6, G5, G3
MPI 119	(Jan 2004) Exterior Latex, Gloss
MPI 141	(Jan 2004) Interior High Performance Latex MPI Gloss Level 5

MPI 145	(Jan 2004) Institutional Low Odor / VOC Interior Latex, MPI Gloss Level 3
MPI 147	(Jan 2004) Institutional Low Odor / VOC Interior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 39	(Jan 2004) Interior Latex-Based Wood Primer
MPI 4	(Jan 2004) Interior/Exterior Latex Block Filler
MPI 48	(Jan 2004) Interior Alkyd, Gloss, MPI Gloss Level 6
MPI 50	(Jan 2004) Interior Latex Primer Sealer
MPI 7	(Jan 2004) Exterior Oil Wood Primer
MPI 79	(Jan 2004) Alkyd Anti-Corrosive Metal Primer

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Guide 3	(1982; R 1995) A Guide to Safety in Paint Application
SSPC PA 1	(2000) Shop, Field, and Maintenance Painting
SSPC SP 1	(1982; R 2000) Solvent Cleaning
SSPC SP 10	(2000) Near-White Blast Cleaning
SSPC SP 12	(2002) Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating
SSPC SP 2	(1982; R 2000) Hand Tool Cleaning
SSPC SP 3	(1982; R 2000) Power Tool Cleaning
SSPC SP 6	(2000) Commercial Blast Cleaning
SSPC SP 7	(2000) Brush-Off Blast Cleaning
SSPC VIS 1	(2002) Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC VIS 3	(1993; R 2000) Visual Standard for Power-and Hand-Tool Cleaned Steel
SSPC VIS 4	(2001) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

SD-02 Shop Drawings

Piping identification

Submit color stencil codes

SD-03 Product Data

Coating

Manufacturer's Technical Data Sheets

MSDS of paints and coatings used within the building interior, highlighting VOC content.

SD-04 Samples

Color

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

SD-10 Operation and Maintenance Data

Coatings:

Cleaning and maintenance instructions for all coating systems shall be provided.

1.3 APPLICATOR'S QUALIFICATIONS

1.4 QUALITY ASSURANCE

1.4.1 Field Samples and Tests

The Owner may choose up to two coatings that have been delivered to the site to be tested at no cost to the Owner. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that confrom to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the

Owner.

1.4.1.1 Sampling Procedure

The Owner will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one quart samples of the selected paint materials. The samples shall be taken in the presence of the Owner, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

1.4.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.5 REGULATORY REQUIREMENTS

1.5.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Owner of any paint specified herein which fails to conform.

1.5.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.5.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.5.4 Asbestos Content

Materials shall not contain asbestos.

1.5.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.5.6 Silica

Abrasive blast media shall not contain free crystilline silica.

1.5.7 Human Carcinogens

Materials shall not contain ACGIH 0100Doc and ACGIH 0100Doc confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.5.8 GS-11 Prohibited Chemicals

methylene chloride
1,1,1-trichloroethane
benzene
toluene (methylbenzene)
ethylbenzene
vinyl chloride
naphthalene
1,2-dichlorobenzene
di (2-ethylhexyl) phthalate
butyl benzyl phthalate
di-n-butyl phthalate
di-n-octyl phthalate
diethyl phthalate
dimethyl phthalate
isophorone
antimony
cadmium
hexavalent chromium
formaldehyde
methyl ethyl ketone
methyl isobutyl ketone
acrolein
acrylonitrile

1.5.9 GS-11, GC-03 & SCAQMD Rule 113 VOC Content Limits

Flat: 50 g/l
Non-flat: 150 g/l
Anti-corrosive & anti-rust: 250 g/l
Clear Wood Finishes, Varnish and Sanding Sealer: 350 g/L
Clear Wood Finishes, Lacquer: 550 g/L
Floor Coatings: 100 g/L.
Shellac, Clear: 730 g/L
Shellac, Pigmented: 550 g/L.
Waterproofing Sealer: 250 g/L.
Waterproofing Concrete/ Masonry Sealer: 400 g/L.
Quick-Dry Sealers & All Other Sealers: 200 g/L.

1.6 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's

formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F.

1.7 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations.

1.7.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC Guide 3.

1.7.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.

b. 29 CFR 1910.1000.

c. ACGIH 0100Doc, threshold limit values.

1.8 ENVIRONMENTAL CONDITIONS

1.8.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 5 degrees F above dew point;

b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

1.9 COLOR SELECTION

Colors of finish coats shall be as indicated herein and in Section 00870. Where not indicated or specified, colors shall be selected by the Architect. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

Color, texture, and pattern of coating systems shall be as indicated on

drawings.

1.10 LOCATION AND SURFACE TYPE TO BE PAINTED

1.10.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

1.10.1.1 Exterior Painting

Includes new surfaces of the buildings and appurtenances.

1.10.1.2 Interior Painting

Includes new surfaces of the buildings and appurtenances as indicated.

1.10.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

e. Hardware, fittings, and other factory finished items.

f. Prefinished wall surface, flooring, and trim.

1.10.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

(1) Exposed piping, conduit, and ductwork;

(2) Supports, hangers, air grilles, and registers;

(3) Miscellaneous metalwork and insulation coverings.

1.10.4 DEFINITIONS AND ABBREVIATIONS

1.10.4.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.10.4.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

1.10.4.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendering, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.10.4.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.10.4.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.10.4.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.10.4.7 EXT

MPI short term designation for an exterior coating system.

1.10.4.8 INT

MPI short term designation for an interior coating system.

1.10.4.9 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.10.4.10 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D 523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.10.4.11 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

1.10.4.12 Paint

See Coating definition.

1.10.4.13 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.10.4.14 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or

otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

Coordinate installation with requirements of Division 1 Section "Construction Indoor Air Quality Management."

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primmed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.3 PREPARATION OF METAL SURFACES

3.3.1 Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/SSPC SP 12 WJ-3.

3.3.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 3.

For abrasive blast cleaned surfaces, the requirements are stated in SSPC SP 7, SSPC SP 6, and SSPC SP 10. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.

For waterjet cleaned surfaces, the requirements are stated in SSPC SP 12. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4.

3.3.3 Galvanized Surfaces

a. Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed

by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D 2092, Appendix X2, and remove by one of the methods described therein.

b. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC SP 12 WJ3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.

3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

a. Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

a. Curing: Concrete, stucco and masonry surfaces shall be allowed to cure at least 30 days before painting, except concrete slab on grade, which shall be allowed to cure 90 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

(1) Dirt, Chalking, Grease, and Oil: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cuphousehold detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water.

(2) Fungus and Mold: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

(3) Loose Particles: Remove by wire brushing.

(4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D 4263 or horizontal surfaces that exceed 3 lbs of moisture

per 1000 square feet in 24 hours as determined by ASTM F 1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 Gypsum Board, Plaster, and Stucco

a. Surface Cleaning: Plaster and stucco shall be clean and free from loose matter; gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.

b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263. New plaster to be coated shall have a maximum moisture content of 8 percent, when measured in accordance with ASTM D 4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

3.5 PREPARATION OF PVC WOOD, AND PLYWOOD SURFACES

3.5.1 New Plywood and Wood Surfaces, Except Floors:

a. Wood surfaces shall be cleaned of foreign matter.

Surface Cleaning: Surfaces shall be free from dust and other deleterious substances and in a condition approved by the Owner prior to receiving paint or other finish. Do not use water to clean uncoated wood. Scrape to remove loose coatings.

b. Lighting sand PVC surface with #200 grit sandpaper to remove gloss from surfaces to be coated.

c. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter in accordance with ASTM D 4444, Method A, unless otherwise authorized.

d. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints.

e. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.

f. Cosmetic Repair of Minor Defects:

(1) Knots and Resinous Wood: Prior to application of coating, cover knots and stains with two or more coats of 3-pound-cut shellac varnish, plasticized with 5 ounces of castor oil per gallon. Scrape away existing coatings from knotty areas, and sand before treating. Prime before applying any putty over shellacked area.

(2) Open Joints and Other Openings: Fill with whiting putty,

linseed oil putty. Sand smooth after putty has dried.

(3) Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.

g. Prime Coat For New Exterior Surfaces: Prime coat exterior wood items before wood becomes dirty, warped, or weathered.

3.6 APPLICATION

3.6.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs,

drops, ridges, waves, laps, brush marks, and variations in colors.

d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

3.6.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.6.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.6.4 Coating Systems

a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table

Division 3. Exterior Concrete Paint Table
Division 4. Exterior Concrete Masonry Units Paint Table
Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table
Division 6. Exterior Wood; Dressed Lumber, Paneling, Decking, Shingles Paint Table
Division 9: Exterior Stucco Paint Table
Division 10. Exterior Cloth Coverings and Bituminous Coated Surfaces Paint Table

Division 3. Interior Concrete Paint Table
Division 4. Interior Concrete Masonry Units Paint Table
Division 5. Interior Metal, Ferrous and Non-Ferrous Paint Table
Division 6. Interior Wood Paint Table
Division 9: Interior Plaster, Gypsum Board, Textured Surfaces Paint Table

b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.

c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar

conditions of exposure.

d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:

(1) One coat of primer.

(2) One coat of undercoat or intermediate coat.

(3) One topcoat to match adjacent surfaces.

e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.7 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.

b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

d. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

e. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.8 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3, 4 and 9 for Exterior and Interior.

3.9 COATING SYSTEMS FOR WOOD AND PLYWOOD

a. Apply coatings of Tables in Division 6 for Exterior and Interior.

b. Prior to erection, apply two coats of specified primer to treat and prime wood and plywood surfaces which will be inaccessible after erection.

c. Apply stains in accordance with manufacturer's printed instructions.

3.10 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with ANSI A13.1. Place stenciling in clearly visible locations. On piping not covered by ANSI A13.1, stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

3.11 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.12 PAINT TABLES

All DFT's are minimum values.

3.12.1 EXTERIOR PAINT TABLES

DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

EXTERIOR GALVANIZED SURFACES

A. New Galvanized surfaces:

1. Epoxy Primer / Waterborne Light Industrial Coating

MPI EXT 5.3K-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 110-G6	MPI 110-G6

System DFT: 5 mils

DIVISION 6: EXTERIOR WOOD AND PVC TRIM PAINT TABLE

A. New exterior, Wood and PVC, trim, not otherwise specified:

1. Latex

MPI EXT 6.3A-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 7	MPI 119	MPI 119

System DFT: 5 mils

3.12.2 INTERIOR PAINT TABLES

DIVISION 3: INTERIOR CONCRETE STAIN TABLE

A. New concrete floors as indicated on drawings:

1. Decorative Stained Concrete

Stain: (3) coats	Topcoat (Sealer):
Penetrating, waterborne stain	Compatible water borne sealer

Stain and Sealer shall be products of one manufacturer.

2. Opaque Concrete Sealer

Primer:	Intermediate Coat:	Topcoat:
Etching Solution	Silicone Acrylic Concrete Sealer	Silicone Acrylic Concrete Sealer

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New Concrete masonry:

1. Institutional Low Odor / Low VOC Latex

New; MPI INT 4.2E-G5 (Semigloss)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 147	MPI 147

System DFT: 10 mils

Fill all holes in masonary surface.

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Metal, Surfaces adjacent to painted surfaces (Match surrounding finish), and miscellan
specified except new prefinished equipment:

1. High Performance Architectural Latex
MPI INT 5.1R-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 141	MPI 141

System DFT: 5 mils

DIVISION 6: INTERIOR WOOD AND PVC PAINT TABLE

A. New PVC trim not otherwise specified:

1. Institutional Low Odor / Low VOC Latex
New; MPI INT 6.3V-G6 Gloss

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 48	MPI 48

System DFT: 4 mils

DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

A. New Wallboard not otherwise specified:

1. Institutional Low Odor / Low VOC Latex
New; MPI INT 9.2M-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 145	MPI 145

System DFT: 4 mils

B. New Wallboard in toilets:

1. MPI INT 9.2M-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 147	MPI 147

System DFT: 4 mils

-- End of Section --

SECTION 10153

TOILET PARTITIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60003	(Basic) Partitions, Toilet, Complete

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation

Drawings showing plans, elevations, details of construction, hardware, reinforcing, fittings, mountings, and anchorings.

SD-03 Product Data

Toilet Partition System

Manufacturer's technical data and catalog cuts including installation and cleaning instructions.

Designation of the percentages of post-consumer and pre-consumer recycled-content in gypsum materials.

SD-04 Samples

Colors and Finishes

Manufacturer's standard color charts and color samples.

1.3 SYSTEM DESCRIPTION

Toilet partition system, including toilet enclosures, room entrance screens, and urinal screens, shall be a complete and usable system of panels, hardware, and support components. The partition system shall be provided by a single manufacturer, and shall be a standard product as shown

in the most recent catalog data. The partition system shall be as shown.

1.4 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the jobsite in the manufacturer's original packaging with the brand, item identification, and project reference clearly marked. Components shall be stored in a dry location that is adequately ventilated; free from dust, water, or other contaminants; and shall have easy access for inspection and handling.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 TOILET ENCLOSURES

Toilet enclosures shall conform to CID A-A-60003, Type I, Style C, overhead braced. Width, length, and height of toilet enclosures shall be as shown. Panels shall be solid phenolic type with laminate-print face as indicated on drawings. Panels indicated to receive toilet paper holders or grab bars as specified in Section 10800 TOILET ACCESSORIES, shall be reinforced for mounting of the items required. Grab bars shall withstand a bending stress, shear stress, shear force, and a tensile force induced by 250 lbf. Grab bars shall not rotate within their fittings. Partitions shall have a post-consumer recycled content no less than 30 percent.

2.2 URINAL SCREENS

Urinal screens shall conform to CID A-A-60003, Type III, Style E, floor to ceiling post supported. Finish surface of screens shall match toilet enclosures. Width and height of urinal screens shall be as shown. Secure wall hung urinal screens with continuous flanges. Urinal screens shall have a post-consumer recycled content no less than 30 Percent.

2.3 HARDWARE

Hardware for the toilet partition system shall conform to CID A-A-60003 for the specified type and style of partitions. Hardware finish shall be highly resistant to alkalies, urine, and other common toilet room acids. Latching devices and hinges for handicap compartments shall comply with 36 CFR 1191 and shall be stainless steel door latches that operate without either tight grasping or twisting of the wrist of the operator. Provide coat hooks with stop bumpers on the back of toilet compartment doors.

2.4 COLORS AND FINISHES

2.4.1 Colors

Color of finishes for toilet partition system components shall be as indicated on the drawings.

2.4.2 Finishes No.4 and No. 5

Fabricated of solid phenolic core with melamine facing sheets or polymer resins (polyethylene) formed under high pressure rendering a single component section not less than one inch thick. Colors shall extend

throughout the panel thickness. Exposed finish surfaces shall be smooth, waterproof, non-absorbant, and resistant to staining and marking with pens, pencils, or other writing devices. Partitions shall not show any sign of deterioration when immersed in the following chemicals and maintained at a temperature of 80 degrees F for a minimum of 30 days:

Acetic Acid (80 percent)	Hydrochloric Acid (40 percent)
Acetone	Hydrogen Peroxide (30 percent)
Ammonia (liquid)	Isopropyl Alcohol
Ammonia Phosphate	Lactic Acid (25 percent)
Bleach (12 percent)	Lime Sulfur
Borax	Nicotine
Brine	Potassium Bromide
Caustic Soda	Soaps
Chlorine Water	Sodium Bicarbonate
Citric Acid	Trisodium Phosphate
Copper Chloride	Urea; Urine
Core Oils	Vinegar

PART 3 EXECUTION

3.1 INSTALLATION

Toilet partitions shall be installed straight and plumb with uniform clearance of 1/2 inch between pilasters and panels; 1 inch between pilasters and walls; and not more than 3/16 inch between pilasters and doors, in accordance with approved manufacturer's instructions with horizontal lines level and rigidly anchored to the supporting construction. Where indicated, anchorage to walls shall be by toggle-bolting. Drilling and cutting for installation of anchors shall be at locations that will be concealed in the finished work. In the finished work, conceal evidence of drilling in floors and walls. Screws and bolts shall be stainless steel.

3.2 ADJUSTING AND CLEANING

Doors shall have a uniform vertical edge clearance of approximately 3/16 inch and shall rest open at approximately 30 degrees when unlatched. Toilet partitions shall be cleaned in accordance with approved manufacturer's instructions and shall be protected from damage until accepted.

-- End of Section --

SECTION 10350

FLAG POLES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 241/B 241M	(1999) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

1.2 SECTION INCLUDES

Aluminum flagpole, ground mounted.

1.3 RELATED SECTIONS

Section 03300 - Cast in Place Concrete: Concrete base and foundation construction.

1.4 PERFORMANCE REQUIREMENTS

Flagpole with Flag Flying: Resistant without permanent deformation to 90 miles/hr wind velocity; non-resonant, safety design factor of 2.5.

1.5 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Indicate detailed dimensions, base attachment details, anchor requirements, and imposed loads.

SD-03 Product Data

Provide data on pole, accessories, and configurations.

1.6 QUALIFICATIONS

Design flagpole foundation supports under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State of Virginia.

1.7 DELIVERY, STORAGE AND HANDLING

Deliver, store, protect and hand products to site under provisions of Section 01600. Spiral wrap flagpole with protective covering and pack in

protective shipping tubes and containers. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

AABEC Pole Div., Morgan-Francis Co., American Flagpole, Division of Kearney-National

BAARTOL Co., Inc.

Concord Industries, Inc.

Eder Flag Manufacturing, Co.

Substitutions: Under provisions of Section 01600.

2.2 POLE MATERIALS

Aluminum: ASTM B 241/B 241M, 6063 T6 alloy.

2.3 POLE CONFIGURATION

Aluminum Flagpoles: Fabricate from seamless extruded tubing complying with ASTM B 241/B 241M, alloy 6063-T6, having a minimum wall thickness of 3/16" (0.1875"), tensile strength not less than 30,000 psi and yield point of 25,000 psi. Heat-treat and age-harden after fabrication.

Provide 25' - 0" height exposed cone tapered aluminum flagpoles where indicated on drawings length measured from nominal ground elevation, ground mounted.

2.4 COMPONENTS AND ACCESSORIES

a. Finial Ball: Manufacturer's standard flush seam ball, size as indicated or, if not indicated, to match pole butt diameter. 14 ga. spun aluminum, with gold anodized finish.

b. Truck: Ball-bearing, non-fouling, revolving, double-track assembly of cast metal, finished to match pole shaft.

c. Cleats: Two 9" cast metal cleats with fasteners, finished to match poleshaft, with tamperproof cleat cover.

d. Halyards: Provide 2 continuous halyards for each flagpole, as follows: Polyrpropylene, white, braided. Size: 5/16: (No. 10)

e. Halyard Flag Snaps: Provide 2 swivel snaps per halyard, as follows, Bronze.

2.5 FINISHES

Aluminum: Fine, directional, mechanical satin polish, (NAAMM-M32), finished as follows: Anodized to dark bronze finish complying with NAAMM-C22A41, Class I (0.7 mil).

2.6 MOUNTING COMPONENETS

Pole Base Attachment: Flush aluminum base with base cover.

Foundation Tube Sleeve: AASHTO-M-36 corrugated 16 gage steel, galvanized, depth as required.

PART 3 EXECUTION

3.1 EXAMINATION

Verify site conditions. Verify that concrete foundation is ready to receive work and dimensions are as indicated on approved shop drawings.

3.2 PREPARATION

Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials wtih asphaltic paint.

3.3 INSTALLATION

a. Install flagpole, base assembly, and fittings in accordance with manufacturer's instructions and specifications.

b. Electrically ground flagpole installation in accordance with manufacturer's instructions and Specifications.

c. Fill foundation tube sleeve with dry sand and compact.

d. Install foundation plate and centering wedges for flagpole base set in concrete base and fasten.

3.4 ERECTION TOLERANCES

Maxinum Variation from Plumb: 1 inch.

3.5 ADJUSTING

a. Adjust work under provisions of Section 01700.

b. Adjust operating devices so that halyard and flag function smoothly.

-- End of Section --

SECTION 10440

INTERIOR SIGNAGE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2604	(2002) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

Drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, shape and thickness of materials, and details of construction. A schedule showing the location, each sign type, and message shall be included.

SD-03 Product Data

Installation

Manufacturer's descriptive data, catalogs cuts, installation and cleaning instructions.

SD-04 Samples

Interior Signage

One sample of each of the following sign types showing typical quality, workmanship and color. The samples may be installed in the work, provided each sample is identified and location recorded.

a. Standard Room sign.

SD-10 Operation and Maintenance Data

Manufacturer's Instructions
Protection and Cleaning

1.3 GENERAL

Interior signage shall be of the design, detail, sizes, types, and message content shown on the drawings/attachments/signage placement schedule (as applicable), shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Signage shall be obtained from a single manufacturer with edges and corners of finished letterforms and graphics true and clean.

1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of such products.

1.5 DELIVERY AND STORAGE

Materials shall be packaged to prevent damage and deterioration during shipment, handling, storage and installation. Product shall be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 ROOM IDENTIFICATION/DIRECTIONAL SIGNAGE SYSTEM

2.1.1 Standard Room Signs

Signs shall consist of laminated thermosetting Type MP plastic (three-ply melamine plastic laminate with phenolic core)and shall conform to the following:

Units shall be frameless. Corners of signs shall be squared.

2.1.2 Type of Mounting For Signs

Surface mounted signs shall be mounted with 1/16 inch thick vinyl foam tape fabricated from materials that are not corrosive to sign material and mounting surface.

2.1.3 Raised and Braille Characters and Pictorial Symbol Signs (Pictograms)

Raised and braille characters and symbols are required on signs that designate permanent rooms or spaces, including restrooms and room numbers. They are not required for information or way-finding signs. Raised letters and numbers on signs must protrude 1/32 inch upper case, sans serif (optima) and shall be accompanied with Grade 2 Braille. Raised characters shall be at least 5/8 inch in height, but no higher than 2 inches. Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be 6 inches minimum in height. Indicated accessible facilities shall use the international symbol of accessibility.

2.2 METAL PLAQUES

2.2.1 Cast Metal Plaques

2.2.1.1 Fabrication

Cast metal plaques shall have the logo, emblem and artwork cast in the bas relief. Plaques shall be fabricated from prime aluminum.

2.2.1.2 Border

Border shall be bevel.

2.2.1.3 Background

Background texture shall be fine pebble.

2.2.1.4 Mounting

Mounting shall be concealed.

2.2.1.5 Finish

Finishes shall consist of aluminum with background sprayed dark gunmetal colored lacquer. Letters shall be satin polished and entire plaque sprayed with two coats clear lacquer.

2.3 DIMENSIONAL BUILDING LETTERS

2.3.1 Fabrication

Letters shall be fabricated from cast aluminum. Letters shall be cleaned by chemical etching or cleaned ultrasonically in a special degreasing bath. Letters shall be packaged for protection until installation.

2.3.2 Typeface

Typeface shall be Optima.

2.3.3 Size

Letter size shall be 5".

2.4 ORGANIC COATING

Organic coating shall conform to AAMA 2604, with total dry film thickness not less than 1.2 mils.

2.5 FABRICATION AND MANUFACTURE

2.5.1 Factory Workmanship

Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable.

2.5.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

2.6 COLOR, FINISH, AND CONTRAST

Color shall be as indicated on the drawings. Finish of all signs shall be eggshell, matte, or other non-glare finish as required in handicapped-accessible buildings.

PART 3 EXECUTION

3.1 INSTALLATION

Signs shall be installed plumb and true and in accordance with approved manufacturer's instructions at locations shown on the drawings. Mounting height shall be 60 inch above the finish floor to the centerline of the sign. Distance from edge of door frame to edge of sign shall be 9 inches minimum. Signs shall be installed on the wall adjacent to the latch side of the door. Where there is no wall space to the latch side of the door, signs shall be placed on the nearest adjacent wall. On double doors the sign shall be located on the inactive leaf. Where both doors are active locate sign to the right of the right-hand door. Signs on doors or other surfaces shall not be installed until finishes on such surfaces have been installed.

SIGNAGE SCHEDULE:

Sign Type	Picto Gram	Braine	Text	Sign Size
A	Yes	Yes	See Drawings	8"W x 8"4 H
B	No	Yes	See Drawings	6"W x 4" H
C	No	No	See Drawings	8"W x 8" H

3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions. Where recommended by signage manufacturer, foam tape pads may be used for anchorage. Foam tape pads shall be minimum 1/16 inch thick closed cell vinyl foam with adhesive backing. Adhesive shall be transparent, long aging, high tech formulation on two sides of the vinyl foam. Adhesive surfaces shall be protected with a 5 mil green flatstock treated with silicone. Foam pads shall be sized for the signage as per signage manufacturer's recommendations.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Other sign surfaces shall be cleaned at completion of sign installation in accordance with the manufacturer's approved instructions.

-- End of Section --

SECTION 10523

PORTABLE FIRE EXTINGUISHERS

PART 1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit Manufacturer's catalog and warranty data for the following items:

Accessories
Cabinets
Wall Brackets

1.2 DELIVERY, HANDLING, AND STORAGE

Protect materials from weather, soil, and damage during delivery, storage, and construction.

Deliver materials in their original packages, containers, or bundles bearing the brand name and the name and type of the material.

PART 2 PRODUCTS

2.1 TYPES

Will be Owner-Furnished, Contractor installed (OFCI).

2.2 SIZE

Coordinate Extinguishers size of OFCI with the Owner prior to ordering cabinets.

2.3 CABINETS

2.3.1 Material

Provide stainless steel cabinets.

2.3.2 Type

Provide semi-recessed cabinet for a 4-inch wall. Cabinet shall protrude no more than 2 1/2" from face of wall.

2.3.3 Size

Dimensions of cabinets must be of adequate size to accommodate the specified fire extinguishers. Coordinate with Owner.

2.4 WALL BRACKETS

Provide wall-hook fire extinguisher wall brackets in lieu of cabinet where

indicated on drawings.

Wall bracket and Accessories must be as approved.

PART 3 EXECUTION

3.1 INSTALLATION

Install OFCI Fire Extinguishers where indicated on the drawings. Verify exact locations prior to installation.

Comply with the manufacturer's recommendations for all installations.

3.2 ACCEPTANCE PROVISIONS

3.2.1 Repairing

Remove and replace damaged and unacceptable portions of completed work with new work at no additional cost to the Government.

Provide Replacement Parts list indicating specified items replacement part, replacement cost, and name, address and contact for replacement parts distributor.

3.2.2 Cleaning

Clean all surfaces of the work, and adjacent surfaces which are soiled as a result of the work. Remove from the site all construction equipment, tools, surplus materials and rubbish resulting from the work.

-- End of Section --

SECTION 10800

TOILET ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 1036 (2001) Flat Glass

1.2 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Finishes
Accessory Items

Manufacturer's descriptive data and catalog cuts indicating materials of construction, fasteners proposed for use for each type of wall construction, mounting instructions, operation instructions, and cleaning instructions.

SD-10 Operation and Maintenance Data

Electric Hand Dryer

Maintenance instructions listing routine maintenance procedures and possible breakdowns. Include repairs instructions for simplified wiring and control diagrams and other information necessary for unit maintenance.

1.3 DELIVERY, STORAGE, AND HANDLING

Wrap toilet accessories for shipment and storage, then delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area protected from construction damage and vandalism.

1.4 WARRANTY

Warrant or guarantee all manufacturer's standard performance that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

Provide toilet accessories in accordance with toilet accessory schedule on drawings. Provide each accessory item with the necessary mounting plates

of sturdy construction with corrosion resistant surface.

2.1.1 Anchors and Fasteners

Provide anchors and fasteners capable of developing a restraining force commensurate with the strength of the accessory to be mounted and suited for use with the supporting construction. Provide tamper proof design exposed fasteners with finish to match the accessory.

2.1.2 Finishes

Except where noted otherwise, provide the following finishes on metal:

Metal	Finish
Stainless steel	No. 4 satin finish
Carbon steel, copper alloy, and brass	Chromium plated, bright

2.2 ACCESSORY ITEMS

Conform to the requirements for accessory items specified below.

2.2.1 Grab Bar

Provide an 18 gauge, 1-1/4 inch grab bar OD Type 304 stainless steel. Provide form and length for grab bar as indicated. Provide concealed mounting flange. Provide grab bar with satin finish. Furnish installed bars capable of withstanding a 500 pound vertical load without coming loose from the fastenings and without obvious permanent deformation. Allow 1-1/2 inch space between wall and grab bar.

2.2.2 Mirrors, Glass

Provide Type I transparent flat type, Class 1-clear glass for mirrors. Glazing Quality q1 1/4 inch thick conforming to ASTM C 1036. Coat glass on one surface with silver coating, copper protective coating, and mirror backing paint. Provide highly adhesive pure silver coating of a thickness which provides reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, free of pinholes or other defects. Provide copper protective coating with pure bright reflective copper, homogeneous without sludge, pinholes or other defects, of proper thickness to prevent "adhesion pull" by mirror backing paint. Provide mirror backing paint with two coats of special scratch and abrasion-resistant paint and baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.2.3 Paper Towel Dispenser

Provide automatic, recessed touchless paper towel dispenser with a Type 304 stainless steel, surface finish. Unit shall be battery operated and shall protrude no more than 4" from the finished wall surface.

2.2.4 Sanitary Napkin Disposer

Construct a Type 304 stainless steel sanitary napkin disposal with removable leak-proof receptacle for disposable liners. Provide fifty disposable liners of the type standard with the manufacturer. Retain

receptacle in cabinet by tumbler lock. Provide disposer with a door for inserting disposed napkins, surface mounted.

2.2.5 Soap Dispenser

Soap dispensers are integral with the specified lavatory system.

2.2.6 Toilet Tissue Dispenser, Jumbo

Provide surface mounted toilet tissue dispenser with 2 rolls of jumbo tissue. Fabricate cabinet of Type 304, 18 gauge stainless steel with Type 304, 20 gauge stainless steel door. Provide cover with key locks. Dispenser shall not extend more than 6" into stall from partition or sidewalk.

2.2.7 Waste Receptacle

Provide Type 304 stainless steel waste receptacle, designed for semi-recessed mounting. Provide reuseable liner, of the type standard with the receptacle manufacturer. Provide a minimum 12 gallon capacity.

2.2.8 Electric Hand Dryer

Provide wall mount and electric hand dryer designed to operate at 110/125 volts, 60 cycle, single phase alternating current with a heating element core rating of a maximum 2100 watts. Provide dryer housing of single piece construction and of white porcelain enamel. Unit shall be semi-recessed and shall protrude no more than 4" from the face of the finished wall surface.

2.2.9 Diaper Changing Station

Provide surface mount diaper changing station and fabricate of high impact plastic with no sharp edges. Concave unit fold down platform to the child's shape, equipped with nylon and Velcro safety straps engineered to withstand a minimum static load of 340 lb. Provide an integral dispenser for sanitary liners for each unit. Provide pictorial for universal use of safety graphics. Provide color as selected by architect.

PART 3 EXECUTION

3.1 INSTALLATION

Provide the same finish for the surfaces of fastening devices exposed after installation as the attached accessory. Provide oval exposed screw heads. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. Use sealants for brackets, plates, anchoring devices and similar items. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

3.1.1 Recessed Accessories

Set anchors in mortar in masonry construction. Fasten to metal studs or framing with sheet metal screws in metal construction.

3.1.2 Surface Mounted Accessories

Conceal fasteners on accessories without backplates. Install accessories with sheet metal screws or wood screws in lead expansion shields, or with toggle bolts or other approved fasteners as required by the construction.

3.2 CLEANING

Clean material in accordance with manufacturer's recommendations. Do not use alkaline or abrasive agents. Take precautions to avoid scratching or marring exposed surfaces.

-- End of Section --

SECTION 12490

WINDOW TREATMENT

PART 1 GENERAL

1.1 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Window Blinds

Manufacturer's data composed of catalog cuts, brochures, product information, and maintenance instructions.

SD-04 Samples

Window Blinds

Samples of each type and color of window treatment. Blind slats or louvers must be 6 inch in length for each color. Track must be 6 inch in length. Shade material must be minimum 6 by 6 inch in size.

SD-10 Operation and Maintenance Data

Window Blinds

1.2 GENERAL

Window treatment must be provided, complete with necessary brackets, fittings, and hardware. Each window treatment type must be a complete unit provided as shown on drawings. Equipment must be mounted and operated as per manufacturer's instructions. Windows to receive a treatment must be completely covered. The Contractor must take measurements at the building and must be responsible for the proper fitting and hanging of the equipment.

1.3 DELIVERY, STORAGE, AND HANDLING

Components must be delivered to the jobsite in the manufacturer's original packaging with the brand or company name, item identification, and project reference clearly marked. Components must be stored in a dry location that is adequately ventilated and free from dust, water, or other contaminants and must have easy access for inspection and handling. Materials must be stored flat in a clean dry area with temperature maintained above 50 degrees F. Do not open containers until needed for installation unless verification inspection is required.

1.4 FIELD MEASUREMENTS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the Atchitect of any discrepancy before performing the work.

1.5 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 WINDOW BLINDS

Provide each blind, including hardware, accessory items, mounting brackets and fastenings, as a complete unit produced by one manufacturer. All parts must be one color unless otherwise indicated, and match the color of the blind slat. Treat steel features for corrosion resistance.

2.1.1 Horizontal Blinds

Horizontal blinds shall be Type II (one inch slats), except as modified below. Blind units shall be capable of nominally 180 degree partial tilting operation and full-height raising. Blinds must be inside mount. Tapes for Type II slats should be braided polyester or nylon.

2.1.1.1 Head Channel and Slats

Head channel must be steel or aluminum with corrosion-resistant finish nominal 0.024 inch for Type II. Slats shall be aluminum, not less than 0.006 inch thick, and of sufficient strength to prevent sag or bow in the finished blind. A sufficient amount of slats must be provided to assure proper control, uniform spacing, and adequate overlap. All hardware must be enclosed in the headrail.

2.1.1.2 Controls

The slats must be tilted by a transparent tilting wand, hung vertically by its own weight, and must swivel for easy operation. The tilter control mustbe of enclosed construction. Moving parts and mechanical drive must be made of compatible materials which do not require lubrication during normal expected life. The tilter must tilt the slats to any desired angle and hold them at that angle so that any vibration or movement of ladders and slats will not drive the tilter and change the angle of slats. A mechanism must be included to prevent over tightening. The wand must be of sufficient length to reach to within five feet of the floor.

2.1.1.3 Intermediate Brackets

Intermediate brackets must be provided for installation of blinds over 48 inch wide and must be installed as recommended by the manufacturer.

2.1.1.4 Bottom Rail

Bottom rail must be a minimum of steel, corrosion-resistant, with baked-on polyester paint, color coordinated with slats. The bottom rail must be formed with a double-lock seam into a closed oval shape for optimum strength. End caps must provided and match the rail in color.

2.1.1.5 Braided Ladders

Ladders must be braided of 100 percent polyester yarn of a color to match the slat color. Spacing of ladders must be a maximum of and a minimum 15.2 slats per foot of drop and spaced in order to provide a uniform overlap of

the slats in a closed position.

2.2 COLOR

Color, pattern and texture is indicated on the drawings. Color listed is not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 IDENTIFICATION

In accordance with the numbering plan, mark each opening and the corresponding window treatment with identical numbers. For multiple windows separated by mullions, the space required by each blind must be numbered separately. Use brass, aluminum, plastic, durable paper plates, or stamp to place corresponding numbers on unexposed surfaces of openings and inside or on top of the headrail track.

3.2 INSTALLATION

3.2.1 Window Blinds

Installation must be in accordance with the approved detail drawings and manufacturer's installation instructions. Units must be level, plumb, secure, and at proper height and location relative to window units. The Contractor must furnish and install supplementary or miscellaneous items in total, including clips, brackets, or anchorages incidental to or necessary for a sound, secure, and complete installation. Installation must not be initiated until completion of room painting and finishing operations.

3.3 CLEAN-UP

Upon completion of the installation, window treatments must be adjusted for form and appearance, must be in proper operating condition, and must be free from soiling, damage or blemishes. Damaged units must be repaired or replaced by the Contractor as directed by the Contracting Officer. Isolate metal parts from direct contact with concrete, mortar, or dissimilar metals. Ensure blinds installed in recessed pockets can be removable without disturbing the pocket. The entire blind, when retracted, shall be contained behind the pocket. For blinds installed outside the jambs and mullions, overlap each jamb and mullion 0.75 inch or more when the jamb and mullion sizes permit. Include all hardware, brackets, anchors, fasteners, and accessories necessary for a complete, finished installation.

-- End of Section --

PROJECT MANUAL

VIRGINIA DEPARTMENT OF TRANSPORTATION: NEW KENT SAFETY REST AREA & INFORMATION CENTER

PROJECT CODE: 501-06501-005
IFB – 743-RD

VOLUME 2 OF 2

DJG, INC.
449 MCLAWS CIRCLE
WILLIAMSBURG, VIRGINIA 23185

DJG COMMISSION NO: 2070030

DATE: AUGUST 3, 2006

PROJECT TABLE OF CONTENTS

DOCUMENTS 00 - INTRODUCTORY, BIDDING, AND CONTRACT REQUIREMENTS

00870 DESIGN SELECTION SUMMARY

DIVISION 01 - GENERAL REQUIREMENTS

01039 COORDINATION AND MEETINGS
01110 SUMMARY OF WORK
01150 LEED GREEN BUILDING SUMMARY, REQUIREMENTS AND GOALS
01300 SUBMITTAL PROCEDURES
01400 QUALITY CONTROL
01450 INDOOR AIR QUALITY MANAGEMENT
01500 TEMPORARY CONSTRUCTION FACILITIES
01550 CONSTRUCTION WASTE MANAGEMENT
01590 FIELD OFFICES AND SHEDS
01600 PRODUCT REQUIREMENTS
01700 CLOSEOUT PROCEDURES
01781 OPERATION AND MAINTENANCE DATA
01810 GENERAL COMMISSIONING REQUIREMENTS
01815 HVAC COMMISSIONING REQUIREMENTS
01820 DEMONSTRATION AND TRAINING

DIVISION 02 - SITE CONSTRUCTION

02100 ASBESTOS REMOVAL IN OCCUPIED BUILDINGS NEW KENT REST AREA COMPLEX
02231 CLEARING AND GRUBBING
02315 EXCAVATION, FILLING, AND BACKFILLING
02360 SOIL TREATMENT FOR SUBTERRANEAN TERMITE CONTROL
02510 WATER DISTRIBUTION
02531 SANITARY SEWERS
02630 STORM DRAINAGE
02631 CISTERN
02761 PAVEMENT MARKINGS
02770 CONCRETE SIDEWALKS AND CURBS AND GUTTERS
02870 SITE FURNISHINGS
02921 SEEDING
02930 EXTERIOR PLANTS
02935 LANDSCAPE ESTABLISHMENT

DIVISION 03 - CONCRETE

03200 CONCRETE REINFORCEMENT
03300 CAST-IN-PLACE STRUCTURAL CONCRETE

DIVISION 04 - MASONRY

04200 MASONRY

DIVISION 05 - METALS

05120 STRUCTURAL STEEL

DIVISION 06 - WOOD AND PLASTICS

06100 ROUGH CARPENTRY
06193 METAL PLATE CONNECTED WOOD TRUSSES
06200 FINISH CARPENTRY
06410 LAMINATE CLAD ARCHITECTURAL CASEWORK
06650 SOLID POLYMER (SOLID SURFACING) FABRICATIONS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07112 BITUMINOUS DAMPPROOFING
07212 MINERAL FIBER BLANKET INSULATION
07213 NATURAL COTTON THERMAL BLANKET INSULATION
07310 SYNTHETIC SLATE ROOFING
07625 COPPER SHEET METAL FLASHING
07920 JOINT SEALANTS

DIVISION 08 - DOORS AND WINDOWS

08110 STEEL DOORS AND FRAMES
08120 ALUMINUM DOORS AND FRAMES
08330 OVERHEAD ROLLING DOORS
08460 AUTOMATIC ENTRANCE DOORS
08520 ALUMINUM WINDOWS
08710 DOOR HARDWARE
08805 GLASS AND GLAZING

DIVISION 09 - FINISHES

09250 GYPSUM BOARD
09445 RESINOUS TERRAZZO FLOORING
09510 ACOUSTICAL CEILINGS
09670 TROWEL APPLIED EPOXY FLOORING
09900 PAINTS AND COATINGS

DIVISION 10 - SPECIALTIES

10153	TOILET PARTITIONS
10350	FLAG POLES
10440	INTERIOR SIGNAGE
10523	PORTABLE FIRE EXTINGUISHERS
10800	TOILET ACCESSORIES

DIVISION 12 - FURNISHINGS

12490	WINDOW TREATMENT

DIVISION 15 - MECHANICAL

15003	GENERAL MECHANICAL PROVISIONS
15050	BASIC MECHANICAL MATERIALS AND METHODS
15072	VIBRATION ISOLATION FOR AIR CONDITIONING EQUIPMENT
15080	MECHANICAL INSULATION
15110	VALVES
15181	HYDRONIC WATER PIPING SYSTEMS
15400	PLUMBING, GENERAL PURPOSE
15410	PLUMBING FIXTURES
15520	EXTERIOR GROUND LOOP HEAT EXCHANGERS
15521	GEOTHERMAL HEAT PUMP AND LOOP PIPING SYSTEMS (HIGH DENSITY POLYETHYLENE)
15522	THERMAL-ENHANCED BENTONITE GROUT
15740	GROUND SOURCE HEAT PUMPS
15741	100% O.A. GROUND SOURCE HEATPUMP WITH ENERGY RECOVERY WHEEL
15810	DUCTWORK AND DUCTWORK ACCESSORIES
15900	AUTOMATIC TEMPERATURE CONTROLS
15910	DIRECT DIGITAL CONTROL SYSTEMS
15950	HVAC TESTING/ADJUSTING/BALANCING

DIVISION 16 - ELECTRICAL

16050	BASIC ELECTRICAL MATERIALS AND METHODS
16234	DIESEL ENGINE-GENERATOR SETS - PRIME AND STANDBY - 10 TO 500 KW
16262	AUTOMATIC TRANSFER SWITCH
16402	INTERIOR DISTRIBUTION SYSTEM
16510	INTERIOR LIGHTING
16520	EXTERIOR LIGHTING
16751	CLOSED CIRCUIT TELEVISION SYSTEMS
	APPENDIX A-GHX INSPECTION AND TEST REPORT (FORM 1)

APPENDIX B-GEOTECHNICAL REPORT FOR INFORMATION PURPOSES ONLY
APPENDIX C-500-MILE RADIUS MAP (WASHINGTON DC)
APPENDIX D- LEED CHECKLIST
APPENDIX E - PHASE II ENVIRONMENTAL SITE ASSESSMENT

-- End of Project Table of Contents --

SECTION 15003

GENERAL MECHANICAL PROVISIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1	(1996) Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(1997e1) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM B 766	(2003) Standard Specification for Electrodeposited Coatings of Cadmium

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1650	(1998) Seismic Restraint Manual: Guidelines for Mechanical Systems

UNDERWRITERS LABORATORIES (UL)

UL 6	(2000; Rev thru May 2003) Rigid Metal Conduit
UL Bld Mat Dir	(2003) Building Materials Directory

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 82	(1996) Protection of Stratospheric Ozone

1.2 SUBMITTALS

Not Used

1.3 COORDINATION

Contractor shall coordinate the work of the different trades so that interference between piping, equipment, structural, and electrical work will be avoided. All necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work properly shall be furnished complete in place at no additional cost to the Government.

1.4 MECHANICAL SYSTEMS IDENTIFICATION

1.4.1 Diagrams

Chart listing of equipment shall be by designation numbers and capacities such as flow rates, pressure and temperature differences, heating and cooling capacities, horsepower, pipe sizes, and voltage and current characteristics. This requirement shall not apply for accessories or minor equipment items, such as vents, but is required for such equipment as pumps, water heaters, air-handling system equipment, refrigeration compressors, heat exchangers, and boilers.

Diagrams shall be neat mechanical drawings provided with extruded aluminum frames and 1/8-inch acrylic plastic protection. Location shall be as directed by the Architect/Engineer firm. The number of charts and diagrams shall be equal to or greater than the number of mechanical equipment rooms. Where more than one chart per space is required, these shall be mounted in edge pivoted, swinging leaf, extruded aluminum frame holders which open to 170 degrees.

1.4.2 Identification Tags

Identification tags made of brass or aluminum indicating function of a control or similar component shall be installed on such system devices. Tags shall be 2 inches in diameter and marking shall be stamped.

Equipment shall be provided with metal identification tags displaying an equipment designation number matching drawing or control diagram designation.

Tags shall be wired to valve or equipment items with No. 12 AWG 0.0808-inch diameter corrosion-resistant steel wire.

1.4.3 Service Labeling

All piping, including that concealed in accessible spaces; exposed, bare and painted; and insulated, shall be labeled to designate service. Each label shall include an arrow or arrows to indicate flow direction. Labels and valve tag schedule shall be in accordance with the typical examples below:

SERVICE	LABEL AND TAG DESIGNATION
Cold potable water	COLD POT. WATER
Hot potable water supply	HOT POT. WATER SUPPLY
Hot potable water return	HOT POT. WATER RETURN
Harvested rain water	RAIN WATER (RECYCLE)
Sanitary sewer	SAN. SEWER
Sanitary waste	SAN. WASTE
Sanitary drain	SAN. DRAIN
Sanitary vent	SAN. VENT

Storm drain	STORM DRAIN
Automatic temperature control	AUTO. TEMP. CONTROL
Geothermal water-supply	GEOTHERMAL SUPPLY
Geothermal water-return	GEOTHERMAL RETURN

Similar services with different temperatures or pressures shall be identified. Where pressures may exceed 125 pounds per square inch, gage, the maximum system pressure shall be included in the label.

Piping shall be labeled and arrowed in accordance with the following:

Each point of entry and exit of pipe passing through walls

Each change in direction, i.e., elbows, tees

In congested or hidden areas and at all access panels at each point required to clarify service or indicated hazard.

In long straight runs, labels shall be located at distances within eyesight of each other but in no case shall the distance between labels exceed 75 feet. All labels shall be visible and legible from the primary service and operating area.

For Bare or Insulated Pipes for Outside Diameters of	Lettering
1/2 thru 1-3/8 inch	1/2 inch
1-1/2 thru 2-3/8 inch	3/4 inch
2-1/2 inch and larger	1-1/4 inch

Labels shall be made of pretensioned pipe markers, plastic film designed for permanent installation.

1.5 COLOR CODING

Color coding of all piping systems shall be in accordance with ANSI A13.1.

1.6 APPROVAL REQUIREMENTS

Except as otherwise specified, approval of materials and equipment will be based on manufacturer's published data.

Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL Bld Mat Dir, and UL 6 will be acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, the Contractor may submit a written certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Methods of testing used by the specified agencies shall be outlined.

Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the ASTM International (ASTM), the ASME International (ASME), or other standards, a manufacturer's

certificate of compliance of each item will be acceptable as proof of compliance.

Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

1.7 PREVENTION OF CORROSION

Metallic materials shall be protected against corrosion. Equipment enclosures shall be given rust-inhibiting treatment and standard finish by the manufacturer. Aluminum shall not be used in contact with earth, and where connected to dissimilar metal, shall be protected by approved fittings, barrier material, or treatment. Ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized in accordance with ASTM A 123/A 123M for exterior locations and cadmium-plated in conformance with ASTM B 766 for interior locations.

1.8 OZONE DEPLETING SUBSTANCES USED AS REFRIGERANTS

Releases of Ozone Depleting Substances (ODS) during repair, maintenance, servicing or disposal of appliances containing ODS's will be minimized by complying with all applicable sections of 40 CFR 82 Part 82 Subpart F. Any person conducting repair, maintenance, servicing or disposal of appliances owned by NASA comply with the following:

No Class I or Class II substances used as a refrigerant may be knowingly vented or otherwise released into the environment.

No appliances may be opened without meeting the requirements of 40 CFR 82 Part 82.156 Subpart F, regarding required practices regarding evacuation and collection of refrigerant, and 40 CFR 82 Part 82.158 Subpart F, regarding standards of recycling and recovery equipment.

No work may be conducted on appliances containing refrigerant except by persons who comply with 40 CFR 82 Part 82.161 Subpart F, regarding technician certification.

In addition, copies of all applicable certifications must be provided to the Architect/Engineer firm at least 14 calendar days prior to initiating maintenance, repair, servicing, dismantling or disposal of appliances, including:

Proof of Technician Certification

Proof of Equipment Certification, if recovery or recycling equipment is to be provided by the Contractor

Proof of availability of certified recovery or recycling equipment, if equipment is to be provided by the Contractor

1.9 USE OF OZONE DEPLETING SUBSTANCES, OTHER THAN REFRIGERANTS

The use of Class I or Class II ODS's listed as nonessential in 40 CFR 82 Part 82.66 Subpart C is prohibited. These prohibited materials and uses include:

Any plastic party spray streamer or noise horn which is propelled by a

chlorofluorocarbon

Any cleaning fluid for electronic and photographic equipment which contains a chlorofluorocarbon; including liquid packaging, solvent wipes, solvent sprays, and gas sprays

Any plastic flexible or packaging foam product which is manufactured with or contains a chlorofluorocarbon, including, open cell foam, open cell rigid polyurethane poured foam, closed cell extruded polystyrene sheet foam, closed cell polyethylene foam and closed cell polypropylene foam except for flexible or packaging foam used in coaxial

Any aerosol product or other pressurized dispenser which contains a chlorofluorocarbon, except for those listed in 40 CFR 82 Part 82.66 Subpart C.

A waiver may be requested should a programmatic of facility requirement dictate that a prohibited material is necessary to achieve project goals. A waiver request must be submitted in writing to the Architect/Engineer firm. The waiver will be evaluated and dispositioned.

PART 2 PRODUCTS

2.1 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, engraved laminated phenolic identification plates shall be provided for each piece of mechanical equipment. Identification plates shall designate the function of the equipment. Designation shall be submitted with the shop drawings.

Identification plates shall be three layers, black-white-black, engraved to show white letters on black background. Letters shall be upper case. Identification plates 1-1/2-inches high and smaller shall be 1/16-inch thick, with engraved lettering 1/8-inch high; identification plates larger than 1-1/2-inches high shall be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger shall have beveled edges. Identification plates shall be installed using a compatible adhesive.

All adhesive shall have a VOC content not more than 70 g/l.

2.2 ANCHOR BOLTS

Anchor bolts shall be provided for equipment placed on concrete equipment pads or on concrete slabs. Bolts shall be of the size and number recommended by the equipment manufacturer and shall be located by means of suitable templates. Installation of anchor bolts shall not degrade the surrounding concrete.

2.3 SEISMIC ANCHORAGE

Equipment shall be anchored in accordance with applicable seismic criteria for the area and as defined in SMACNA 1650

2.4 PAINTING

Equipment units shall be painted in accordance with approved equipment

manufacturer's standards unless specified otherwise. Field retouching shall be accomplished only if approved; otherwise equipment shall be returned to the factory for refinishing.

PART 3 EXECUTION

3.1 INSTALLATION

Materials and equipment shall be installed in accordance with the requirements of the contract drawings and approved recommendations of the manufacturers. Installation shall be accomplished by workers skilled in this type of work. Installation shall be made so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.

No installation shall be permitted which blocks or otherwise impedes access to any machine or system. All hinged doors shall swing open a minimum of 120 degrees. The area in front of all access doors shall be clear a minimum of 3feet. The area in front of all access doors to electrical circuits shall be clear the minimum distance to energized circuits as specified in OSHA Standards, part 1910.333(Electrical-Safety Related work practices)and an additional 3 feet.

Except as otherwise indicated, emergency switches and alarms shall be installed in conspicuous locations. All indicators, to include gauges, meters, and alarms shall be mounted in order to be easily visible by people in the area.

3.2 EQUIPMENT PADS

Equipment pads shall be provided and shall be of dimensions shown or, if not shown, they shall conform to the shape of each piece of equipment served with a minimum 3-inch margin around the equipment and supports. Equipment bases and foundations, when constructed of concrete or grout, shall cure a minimum of 14 calendar days before being loaded.

3.3 CUTTING AND PATCHING

Contractor shall install his work in such a manner and at such time as will require a minimum of cutting and patching of the building structure.

Holes in exposed locations, in or through existing floors, shall be drilled and smoothed by sanding. Use of a jackhammer will be permitted only where specifically approved.

Holes through masonry walls to accommodate sleeves shall be made with an iron pipe masonry core saw.

3.4 CLEANING

Exposed surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction shall be thoroughly cleaned before such surfaces are prepared for final finish painting or are enclosed within the building structure.

Before final acceptance, mechanical equipment, including piping, ducting, and fixtures, shall be clean and free from dirt, grease, and finger marks.

-- End of Section --

SECTION 15050

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	(2001; 3rd Ed) LRFD Manual of Steel Construction

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B40.1	(1991; R 1997) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN WELDING SOCIETY (AWS)

AWS WHB-2.8	(1991; 8th Ed) Welding Handbook; Volume Two - Welding Processes

ASME INTERNATIONAL (ASME)

ASME A112.18.1	(2003) Plumbing Fixture Fittings
ASME A112.19.2M	(2003) Vitreous China Plumbing Fixtures
ASME B1.20.7	(1991; R 2003) Hose Coupling Screw Threads (Inch)
ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.22	(2002) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions
ASME B16.5	(2003) Pipe Flanges and Flanged Fittings
ASME B16.9	(2003) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.3	(1999) Process Piping
ASME BPVC SEC IX	(2001) Boiler and Pressure Vessel Code;

	Section IX, Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2001) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASTM INTERNATIONAL (ASTM)

ASTM A 197/A 197M	(2000) Standard Specification for Cupola Malleable Iron
ASTM A 234/A 234M	(2004) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 307	(2000) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 53/A 53M	(2004a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 563	(2004) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 6/A 6M	(2001b) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 74	(2004a) Cast Iron Soil Pipe and Fittings
ASTM B 32	(2004) Solder Metal
ASTM B 370	(2003) Copper Sheet and Strip for Building Construction
ASTM B 62	(2002) Composition Bronze or Ounce Metal Castings
ASTM B 749	(2003) Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products
ASTM B 88	(2003) Seamless Copper Water Tube
ASTM C 109/C 109M	(2002) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C 404	(2003) Standard Specification for Aggregates for Masonry Grout
ASTM C 476	(2002) Grout for Masonry
ASTM C 553	(2002) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 564	(2003a) Rubber Gaskets for Cast Iron Soil

	Pipe and Fittings
ASTM C 67	(2003a) Sampling and Testing Brick and Structural Clay Tile
ASTM C 920	(2002)Elastomeric Joint Sealants
ASTM E 814	(2000) Fire Tests of Through-Penetration Fire Stops
ASTM F 104	(2003) Standard Classification System for Nonmetallic Gasket Materials

FLUID SEALING ASSOCIATION (FSA)

FSA-0017	(1995) Non-Metallic Expansion Joints and Flexible Pipe Connectors Technical Handbook, 6th Edition

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2002) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(2002) Pipe Hangers and Supports - Selection and Application

UNDERWRITERS LABORATORIES (UL)

UL 1479	(2003) Fire Tests of Through-Penetration Firestops

U.S. DEPARTMENT OF DEFENSE (DOD)

MS MIL-C-18480	(1987b) Coating Compound, Bituminous, Solvent, Coal-Tar Base

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS FF-S-325	(Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)

1.2 GENERAL REQUIREMENTS

Equipment Foundation Data for piping systems shall include plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

Material, Equipment, and Fixture Lists shall be submitted for pipes, valves and specialties including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information. A complete list of construction equipment to be used shall be provided.

Manufacturer's Standard Color Charts shall be submitted for pipes, valves and specialties showing the manufacturer's recommended color and finish

selections.

Listing of Product Installations for piping systems shall include identification of at least 5 units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. List shall include purchaser, address of installation, service organization, and date of installation.

Record Drawings shall be submitted for pipes, valves and accessories providing current factual information including deviations and amendments to the drawings, and concealed and visible changes in the work.

Connection Diagrams shall be submitted for pipes, valves and specialties indicating the relations and connections of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists shall be submitted for construction equipment to be used.

SD-02 Shop Drawings

The following shall be submitted for pipes, valves and specialties showing conformance with the referenced standards contained within this section.

Record Drawings
Connection Diagrams
Coordination Drawings
Fabrication Drawings

Installation Drawings shall be submitted for pipes, valves and specialties in accordance with the paragraph entitled, "Pipe Installation," of this section.

SD-03 Product Data

Equipment and performance data shall be submitted for the following items consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis.

Manufacturer's catalog data shall be submitted for the following items:

Pipe and Fittings
Piping Specialties
Valves
Miscellaneous Materials
Supporting Elements
Adhesives, Sealants, and Caulks

Submit MSDS highlighting VOC content for each filed-applied

adhesive, sealant or caulk used in the building interior.

Equipment Foundation Data shall be in accordance with paragraph entitled, "General Requirements," of this section.

SD-06 Test Reports

Test reports on the following tests shall be submitted in accordance with paragraph entitled, "Piping Installation," of this section.

Hydrostatic Tests
Air Tests
Valve-Operating Tests
Drainage Tests
Non-Destructive Electric Tests
System Operation Tests

SD-07 Certificates

Listing of Product Installations for piping systems shall be submitted verifying proper qualifications.

Records of Existing Conditions shall be submitted by the Contractor prior to start.

Certificates shall be submitted for the following in accordance with paragraph entitled, "Pipe Installation," of this section.

Surface Resistance
Shear and Tensile Strengths
Temperature Ratings
Bending Tests
Flattening Tests
Transverse Guided Weld Bend Tests

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with paragraph entitled, "Operation and Maintenance," of this section.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 Black Carbon Steel

Indoor pipe (1/8 through 12 inches) shall be Schedule 40 black carbon steel, conforming to ASTM A 53/A 53M or Type L Copper.

Refer to Section 15521 for Geothermal piping outdoors.

Fittings (2 inches and under) shall be 150-pounds per square inch, gage (psig) working steam pressure (wsp) banded black malleable iron screwed, conforming to ASTM A 197/A 197M and ASME B16.3.

Unions (2 inches and under) shall be 250 pounds per square inch, wsp female, screwed, black malleable iron with brass-to-iron seat, and ground

joint, conforming to ASME B16.39.

Fittings (2-1/2 inches and over) shall be Steel butt weld, conforming to ASTM A 234/A 234M and ASME B16.9 to match pipe wall thickness.

Flanges (2-1/2 inches and over) shall be 150-pound forged-steel conforming to ASME B16.5, welding neck to match pipe wall thickness.

2.1.2 Type CISP-DWV, Cast-Iron Drain, Waste and Vent

Soil pipe drain, waste, and vent bell-and-spigot type pipe shall be cast iron, conforming to ASTM A 74. Joints shall be calked and leaded in lines where necessary to provide proper leaktight support and alignment; other-wise joints may be two-gasket system type chloroprene, conforming to ASTM C 564. Pipe class shall be extra heavy (CISP-DWV-XH).

2.1.3 Copper

2.1.3.1 Copper Above Ground

Tubing (2 inches and under) shall be seamless copper tubing, conforming to ASTM B 88, Type L (hard-drawn for all horizontal and all exposed vertical lines, annealed for concealed vertical lines).

Fittings (2 inches and under) shall be 150-psig wsp wrought-copper solder joint fittings conforming to ASME B16.22.

Unions (2 inches and under) shall be 150-psig wsp wrought-copper solder joint, conforming to ASME B16.22.

Solder shall be 60-40 tin-antimony, alloy Sb-5, conforming to ASTM B 32.

2.1.3.2 Copper Under Ground (Not for Geothermal)

Piping shall be Type K seamless copper tube, conforming to ASTM B 88. Socket-joint fittings shall be wrought copper, conforming to ASME B16.22. Fittings for connection to corporation cocks shall be cast bronze, flared-type, conforming to ASME B16.26. Joints shall be brazed.

2.2 PIPING SPECIALTIES

2.2.1 Air Separator

Air separated from converter discharge water shall be ejected by a reduced-velocity device vented to the compression tank.

Air separator shall be carbon steel, designed, fabricated, tested, and stamped in conformance with ASME BPVC SEC VIII D1 for service pressures not less than 125 psi.

2.2.2 Air Vents

Manual air vents shall be 3/8-inch ball valves.

2.2.3 Dielectric Connections

Dissimilar pipe metals shall be electrically insulated from each other by couplings, unions, or flanges commercially manufactured for that purpose and rated for the service pressure and temperature.

2.2.4 Expansion Vibration Isolation Joints

Single or multiple arch-flanged expansion vibration isolation joints shall be constructed of steel-ring reinforced chloroprene-impregnated cloth materials. Joint shall be designed to absorb the movement of the pipe sections in which installed with no detrimental effect on the pipe or connected equipment. Flanges shall be backed with ferrous-metal backing rings. Control rod assemblies shall be provided to restrict joint movement. All nonmetallic exterior surfaces of the joint shall be coated with chlorosulphinated polyethylene. Grommets shall be provided in limit bolt hole to absorb noise transmitted through the bolts.

Joints shall be suitable for continuous-duty working temperature of at least 250 degrees F .

Arches shall be filled with soft chloroprene.

Joint, single-arch, movement limitations and size-related, pressure characteristics shall conform to FSA-0017.

2.2.5 Flexible Metallic Pipe

Flexible pipe shall be the bellows-type with Stainless Steel wire braid cover and shall be designed, constructed, and rated in accordance with the applicable requirements of ASME B31.3.

Working pressure minimum rating shall be 150 psi at 300 degrees F.

Minimum burst pressure shall be four times working pressure at 300 degrees F. Bellows material shall be AISI Type 316L corrosion-resistant steel. Braid shall be AISI 300 series corrosion-resistant steel wire.

Flanged end connection rating and materials shall conform to specifications for system primary-pressure rating.

2.2.6 Hose Faucets

Hose faucets shall be constructed with 1/2 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection, conforming to ASME A112.18.1. Hose-coupling screw threads shall conform to ASME B1.20.7.

Vandalproof, atmospheric-type vacuum breaker shall be provided on the discharge of all potable water lines.

2.2.7 Pressure Gages

Pressure gages shall conform to ANSI B40.1 and to requirements specified herein. Pressure-gage size shall be 3-1/2 inches nominal diameter. Case shall be corrosion-resistant steel, conforming to any of the AISI 300 series of ASTM A 6/A 6M, with an ASM No. 4 standard commercial polish or better. Gages shall be equipped with adjustable red marking pointer and damper-screw adjustment in inlet connection. Service-pressure reading shall be at midpoint of gage range. All gages shall be Grade B or better and be equipped with gage isolators.

2.2.8 Sight-Flow Indicators

Sight-flow indicators for pressure service on 3-inch ips and smaller shall

be constructed of bronze with specially treated single- or double-glass sight windows and shall have a bronze, nylon, or tetrafluoroethylene rotating flow indicator mounted on an AISI Type 304 corrosion-resistant steel shaft. Body may have screwed or flanged end. Assembly shall be pressure- and temperature-rated for the applied service. Flapper flow-type indicators are not acceptable.

2.2.9 Sleeve Couplings

Sleeve couplings for plain-end pipe shall consist of one steel middle ring, two steel followers, two chloroprene or Buna-N elastomer gaskets, and the necessary steel bolts and nuts.

2.2.10 Pump Suction Strainers

Strainer body shall be cast iron, rated for not less than 25 psig at 100 degrees F, with flanges conforming to ASME B16.1, Class 125. Strainer construction shall be such that there is a machined surface joint between body and basket that is normal to the centerline of the basket.

Minimum ratio of open area of each basket to pipe area shall be 3 to 1. Basket shall be AISI 300 series corrosion-resistant steel wire mesh with perforated backing.

Mesh shall be capable of retaining all particles larger than 1,000 micrometer, with a pressure drop across the strainer body of not more than 0.5 psi when the basket is two-thirds dirty at maximum system flow rate. Reducing fittings from strainer-flange size to pipe size shall be provided.

A differential-pressure gage fitted with a two-way brass cock shall be provided across the strainer.

Manual air vent cocks shall be provided in cap of each strainer.

2.2.11 Line Strainers, Water Service

Strainers shall be Y-type with removable basket. Strainers in sizes 2-inch ips and smaller shall have screwed ends. In sizes 2-1/2-inch ips and larger, strainers shall have flanged ends. Body working-pressure rating shall exceed maximum service pressure of system in which installed by at least 50 percent. Body shall have cast-in arrows to indicate direction of flow. All strainer bodies fitted with screwed screen retainers shall have straight threads and shall be gasketed with nonferrous metal. Strainer bodies 2-1/2-inches and larger, fitted with bolted-on screen retainers, shall have offset blowdown holes. All strainers larger than 2-1/2-inches shall be fitted with manufacturer's standard ball-type blowdown valve. Body material shall be cast bronze conforming to ASTM B 62. Where system material is nonferrous, metal strainer body material shall be nonferrous metal.

Minimum free-hole area of strainer element shall be equal to not less than 3.4 times the internal area of connecting piping. Strainer screens shall have perforations not to exceed 0.045-inch. Strainer screens shall have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material shall be AISI Type 304 corrosion-resistant steel.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Bituminous Coating

Bituminous coating shall be a solvent cutback, heavy-bodied material to produce not less than a 12-mil dry-film thickness in one coat, and shall be as recommended by the manufacturer to be compatible with factory-applied coating and rubber joints.

For previously coal-tar coated and uncoated ferrous surfaces underground, bituminous coating shall be solvent cutback coal-tar type, conforming to MS MIL-C-18480.

2.3.2 Bolting

Flange and general purpose bolting shall be hex-head and shall conform to ASTM A 307, Grade B (bolts, for flanged joints in piping systems where one or both flanges are cast iron). Heavy hex-nuts shall conform to ASTM A 563. Square-head bolts and nuts are not acceptable. Threads shall be coarse-thread series.

2.3.3 Elastomer Calk

Polysulfide- or polyurethane-base elastomer calking material shall be two-component type, conforming to ASTM C 920.

All caulk shall have a VOC content not to exceed 250 g/l.

2.3.4 Escutcheons

Escutcheons shall be manufactured from nonferrous metals and shall be chrome-plated except when AISI 300 series corrosion-resistant steel is provided. Metals and finish shall conform to ASME A112.19.2M.

Escutcheons shall be one-piece type where mounted on chrome-plated pipe or tubing. All escutcheons shall have provisions consisting of internal spring-tension devices for maintaining a fixed position against a surface.

2.3.5 Flashing

Sheet lead shall conform to ASTM B 749.

Sheet copper shall conform to ASTM B 370 and shall be of not less than 16 ounces per square foot weight.

2.3.6 Flange Gaskets

Compressed non-asbestos sheet, conforming to ASTM F 104, coated on both sides with graphite or similar lubricant, with nitrile composition, binder rated to 750 degrees F.

2.3.7 Grout

Shrink-resistant grout shall be a premixed and packaged metallic-aggregate, mortar-grouting compound conforming to ASTM C 404 and ASTM C 476.

Shrink-resistant grout shall be a combination of premeasured and packaged epoxy polyamide or amine resins and selected aggregate mortar grouting compound conforming to the following requirements:

Tensile strength		1,900 psi, minimum
Compressive strength	ASTM C 109/C 109M	14,000 psi, minimum
Shrinkage, linear		0.00012 inch per inch, maximum
Water absorption	ASTM C 67	0.1 percent, maximum
Bond strength to		1,000 psi, minimum steel in shear minimum

2.3.8 Pipe Thread Compounds

Tetrafluoroethylene tape not less than 2 to 3 mils thick shall be used in potable and process water and in chemical systems for pipe sizes to and including 1-inch ips. Tetrafluoroethylene dispersions and other suitable compounds may be used for all other applications upon approval by the Architect/Engineer firm; however, no lead-containing compounds may be used in potable water systems.

2.3.9 Adhesives and Sealants

All adhesives shall comply with the current VOC content limits, as expressed in grams per liter, or SCAQMD Rule #1168 "Adhesive and Sealant Applications", amended January 7, 2005, as follows:

Multipurpose Construction Adhesives: 70
PVC Welding: 510
CPVC Welding: 490
ABS Welding: 325
Plastic Cement Welding: 250
Adhesive Primer for Plastic: 550
Contact Adhesive: 80
All Other Welding & Installation Adhesives: 250
Sealants: 250

Aerosol Adhesives shall comply with the current VOC Content limits, as expressed in percentage of VOCs by weight, of Green Seal (GS) Standard GS-36 "Commercial Adhesives," October 19, 2000 (for aerosol adhesives only) as follows:

General Purpose Mist Spray: 65% VOCs by weight
General Purpose Web Spray: 55% VOCs by weight
Special Purpose Aerosol Adhesives (all types): 70% VOCs by weight

2.4 SUPPORTING ELEMENTS

All necessary piping systems and equipment supporting elements shall be provided, including but not limited to: building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides; and spring-cushion, variable, or constant supports. All supporting elements shall be suitable for stresses imposed by systems pressures and temperatures and natural and other external forces normal to this facility without damage to supporting element system or to work being supported.

Supporting elements shall conform to requirements of ASME B31.3, FS FF-S-325, MSS SP-58, and MSS SP-69 except as noted.

Attachments welded to pipe shall be made of materials identical to that of pipe or materials accepted as permissible raw materials by referenced code or standard specification.

Supporting elements exposed to weather shall be hot-dip galvanized or stainless steel. Materials shall be of such a nature that their apparent and latent-strength characteristics are not reduced due to galvanizing process. Supporting elements in contact with copper tubing shall be electroplated with copper.

Type designations specified herein are based on MSS SP-58 and MSS SP-69. Masonry anchor group-, type-, and style-combination designations shall be in accordance with FS FF-S-325. Support elements, except for supplementary steel, shall be cataloged, load rated, commercially manufactured products.

2.4.1 Building Structure Attachments

2.4.1.1 Anchor Devices, Concrete and Masonry

Anchor devices shall conform to FS FF-S-325 for the following types:

Group I - shield, expansion (lead, bolt and stud anchors)

Group II - shield, expansion (bolt anchors)

Type 2 - machine bolt expansion shield anchors

Class 2 - open-end expansion shield anchors

Style 1 - single-end expansion shield anchors

Style 2 - double-end expansion shield anchors

Group III - shield, expansion (self-drilling

tubular expansion shell bolt anchors)

Group VIII - anchors, expansion (nondrilling)

Cast-in, floor mounted, equipment anchor devices shall provide adjustable positions.

Masonry anchor devices shall be built-in.

Powder-actuated anchoring devices shall not be used to support any mechanical systems components.

2.4.1.2 C-Clamps

C-clamps shall not be used.

2.4.1.3 Inserts, Concrete

Concrete inserts shall be MSS SP-58 Type 18. When applied to piping in sizes 2 inches ips and larger and where otherwise required by imposed loads, a 1-foot length of 1/2-inch reinforcing rod shall be inserted and wired through wing slots. Proprietary-type continuous inserts may be submitted for approval.

2.4.2 Horizontal Pipe Attachments

2.4.2.1 Single Pipes

Piping in sizes to and including 2-inch ips shall be supported by MSS SP-58 Type 6 solid malleable iron pipe rings, except that split-band-type rings may be used in sizes up to 1-inch ips.

Piping in sizes through 8-inch ips inclusive shall be supported by MSS SP-58 Type 1 attachments.

MSS SP-58 Type 1 and Type 6 assemblies shall be used on vapor-sealed insulated piping and shall have an inside diameter larger than pipe being supported to provide adequate clearance during pipe movement.

Where thermal movement of a point in a piping system 4 inches and larger would cause a hanger rod to deflect more than 4 degrees from the vertical or where a horizontal point movement exceeds 1/2 inch, MSS SP-58 Type 41 pipe rolls shall be used.

MSS SP-58 Type 40 shields shall be used on all insulated piping. Area of the supporting surface shall be such that compression deformation of insulated surfaces does not occur. Longitudinal and transverse shield edges shall be rolled away from the insulation.

Insulated piping without vapor barrier on roll supports shall be provided with MSS SP-58 Type 39 saddles.

Spring supports shall be as indicated.

2.4.2.2 Parallel Pipes

Trapeze hangers fabricated from structural steel shapes, with U-bolts, shall be used in congested areas and where multiple pipe runs occur. Structural steel shapes shall conform to supplementary steel requirements be of commercially available, proprietary design, rolled steel.

2.4.3 Vertical Pipe Attachments

Vertical pipe attachments shall be MSS SP-58 Type 8.

Shop drawing data shall include complete fabrication and attachment details of any spring supports.

2.4.4 Hanger Rods and Fixtures

Only circular cross section rod hangers may be used to connect building structure attachments to pipe support devices.

Turnbuckles, swing eyes, and clevises shall be provided as required by support system to accommodate temperature change, pipe accessibility, and adjustment for load and pitch. Rod couplings are not acceptable.

2.4.5 Supplementary Steel

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, such supplementary steel shall be designed and fabricated in

accordance with AISC 325.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

All branch piping is to come off the top of all mains.

Certificates shall be submitted for pipes, valves and specialties showing conformance with test requirements as contained in the reference standards contained in this section. Certificates shall verify Surface Resistance, Shear and Tensile Strengths, Temperature Ratings, Bending Tests, Flattening Tests and Transverse Guided Weld Bend Tests.

Test reports for Hydrostatic Tests, Air Tests, Valve-Operating Tests, Drainage Tests, Pneumatic Tests, Non-Destructive Electric Tests and System Operation Tests shall be provided by the Contractor, in compliance with referenced standards contained within this section.

Piping systems shall be fabricated and installed in accordance with ASME B31.3, MSS SP-69, and AWS WHB-2.8.

Installation Drawings shall be submitted for pipes, valves and specialties. Drawings shall include the manufacturer's design and construction calculations, forces required to obtain rated axial, lateral, or angular movements, installation criteria, anchor and guide requirements for equipment, and equipment room layout and design. Drawing shall specifically advise on procedures to be followed and provisions required to protect expansion joints during specified hydrostatic testing operations.

Connections between steel piping and copper piping shall be electrically isolated from each other with dielectric couplings (or unions) flanged with gaskets rated for the service.

Final connections to equipment shall be made with unions or flanges provided every 100 feet of straight run. Unions shall be provided in the line downstream of screwed- and welded-end valves.

All pipe ends shall be reamed before joint connections are made.

Screwed joints shall be made up with specified joint compound and not more than three threads shall show after joint is made up.

Joint compounds shall be applied to the male thread only and care shall be exercised to prevent compound from reaching the unthreaded interior of the pipe.

Screwed unions, welded unions, or bolted flanges shall be provided wherever required to permit convenient removal of equipment, valves, and piping accessories from the piping system for maintenance.

Piping systems shall be securely supported with due allowance for thrust forces, thermal expansion and contraction, and shall not be subjected to mechanical, chemical, vibrational or other damage as specified in ASME B31.3.

Field welded joints shall conform to the requirements of the AWS WHB-2.8, ASME B31.3, and ASME BPVC SEC IX.

All necessary precautions shall be taken during installation of flexible

pipe and hose including flushing and purging with water, steam, and compressed air to preclude bellows failure due to pipe line debris lodged in bellows. Installation shall conform to manufacturer's instructions.

3.2 VALVES

Valves shall be provided in piping mains and all branches and at equipment where indicated and as specified.

Valves shall be provided to permit isolation of branch piping and each equipment item from the balance of the system.

Riser and downcomer drains above piping shutoff valves in piping 2-1/2 inches and larger shall be provided. Shutoff valve body shall be tapped and fitted with a 1/2-inch plugged globe valve.

Valves unavoidably located in furred or other normally inaccessible places shall be provided with access panels adequately sized for the location and located so that concealed items may be serviced, maintained, or replaced.

3.3 SUPPORTING ELEMENTS INSTALLATION

Supporting elements shall be provided in accordance with the referenced codes and standards.

Piping shall be supported from building structure. No piping shall be supported from roof deck or from other pipe.

Piping shall run parallel with the lines of the building. Piping and components shall be spaced and installed so that a threaded pipe fitting may be removed between adjacent pipes and so that there shall be no less than 1/2 inch of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Hangers on different adjacent service lines running parallel with each other shall be arranged to be in line with each other and parallel to the lines of the building.

Piping support elements shall be installed at intervals specified hereinafter, at locations not more than 3 feet from the ends of each runout, and not over 1 foot from each change in direction of piping.

Load rating for all pipe-hanger supports shall be based on insulated weight of lines filled with water and forces imposed. Deflection per span shall not exceed slope gradient of pipe. Supports shall be in accordance with the following minimum rod size and maximum allowable hanger spacing for specified pipe. For concentrated loads such as valves, the allowable span shall be reduced proportionately:

PIPE SIZE INCHES	ROD SIZE INCHES	STEEL PIPE FEET	COPPER PIPE FEET
1 and smaller	3/8	8	6
1-1/4 to 1-1/2	3/8	10	8
2	3/8	10	8
2-1/2 to 3-1/2	1/2	12	12

4 to 5	5/8	16	14
6	3/4	16	16
8 to 12	7/8	20	20
14 to 18	1	20	20
20 and over	1-1/4	20	20

Vibration isolation supports shall be provided where needed. Refer to Section 15072S VIBRATION ISOLATION FOR AIR CONDITIONING EQUIPMENT where A/C equipment and piping is installed.

Vertical risers shall be supported independently of connected horizontal piping, whenever practicable, with fixed or spring supports at the base and at intervals to accommodate system range of thermal conditions. Risers shall be guided for lateral stability. For risers subject to expansion, only one rigid support shall be provided at a point approximately one-third down from the top. Clamps shall be placed under fittings unless otherwise specified. Carbon-steel pipe shall be supported at each floor and at not more than 15-foot intervals for pipe 2 inches and smaller and at not more than 20-footintervals for pipe 2-1/2 inches and larger.

3.4 PENETRATIONS

Effective sound stopping and adequate operating clearance shall be provided to prevent structure contact where piping penetrates walls, floors, or ceilings into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces shall include space above ceilings where no special acoustic treatment of ceiling is provided. Penetrations shall be finished to be compatible with surface being penetrated.

Sound stopping and vapor-barrier sealing of pipe shafts and large floor and wall openings shall be accomplished by packing to high density with properly supported fibrous-glass insulation or, where ambient or surface temperatures do not exceed 120 degrees F, by foaming-in-place with self-extinguishing, 2-pound density polyurethane foam to a depth not less than 6 inches. Foam shall be finished with a rasp. Vapor barrier shall be not less than 1/8-inch thick vinyl coating applied to visible and accessible surfaces. Where high temperatures and fire stopping are a consideration, only mineral wool shall be used and openings shall also be covered with 16-gage sheet metal.

3.5 SLEEVES

Sleeves shall be provided where piping passes through roofs, masonry, concrete walls and floors.

Sleeves that extend through floors, roofs, load bearing walls, and fire barriers shall be continuous and fabricated from Schedule 40 steel pipe, with welded anchor lugs. All other sleeves shall be formed by molded linear polyethylene liners or similar materials that are removable. Diameter of sleeves shall be large enough to accommodate pipe, insulation, and jacketing without touching the sleeve and shall provide a minimum 3/8-inch clearance. Sleeve size shall accommodate mechanical and thermal motion of pipe to preclude transmission of vibration to walls and the

generation of noise.

Space between a pipe, bare or insulated, and the inside of a pipe sleeve or a construction surface penetration shall be packed solid with a mineral fiber conforming to ASTM C 553 Type V (flexible blanket), (to 1,000 degrees F). This packing shall be provided wherever the piping passes through firewalls, equipment room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction surface penetrations occur between conditioned and unconditioned spaces, the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction surface penetration shall be filled with an elastomer calk to a depth of 1/2 inch. All surfaces to be calked shall be oil- and grease-free.

Through-Penetration fire stop materials and methods shall be in accordance with ASTM E 814 and UL 1479.

Exterior wall sleeves shall be calked watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed metal components.

3.6 ESCUTCHEONS

Escutcheons shall be provided at all penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, escutcheons shall be provided on both sides of the partition. Where suspended ceilings are installed, plates shall be provided at the underside only of such ceilings. For insulated pipes, the plates shall be large enough to fit around the insulation. Escutcheons shall be chrome-plated in all occupied spaces and of size sufficient to effectively conceal openings in building construction. Escutcheons shall be firmly attached with setscrews.

3.7 FLASHINGS

Flashings shall be provided at penetrations of building boundaries by mechanical systems and related work.

3.8 UNDERGROUND PIPING INSTALLATION

Prior to being lowered into a trench, all piping shall be cleaned, visually inspected for apparent defects, and tapped with a hammer to audibly detect hidden defects.

Suspect cast-ferrous piping shall be further inspected by painting with kerosene on external surfaces to reveal cracks.

Defective materials found shall be distinctly marked using a road-traffic quality yellow paint; defective material shall be promptly removed from the site.

After conduit has been inspected, and not less than 48 hours prior to being lowered into a trench, all external surfaces of cast ferrous conduit shall be coated with a compatible bituminous coating for protection against brackish ground water. Application shall be single coat, in accordance with the manufacturer's instructions, to result in a dry-film thickness of not less than 12 mils.

Excavations shall be dry and clear of extraneous materials when pipe is being laid.

Cutting of piping shall be by wheel cutters or other machines designed specifically for that purpose. Electric-arc and oxyacetylene cutting will not be permitted.

Laying of pipe shall begin at the low point of a system. When in final acceptance position, it shall be true to the grades and alignment indicated, with unbroken continuity of invert. Blocking and wedging will not be permitted.

Changes in direction shall be made with long sweep fittings.

Necessary socket clamping, piers, bases, anchors, and thrust blocking shall be provided. Rods, clamps, and bolting shall be protected with a coating of bitumen.

Underground piping below supported or suspended slabs shall be supported from the slab with a minimum of two supports per length of pipe. Supports shall be protected with a coating of bitumen.

On excavations that occur near and below building footings, the backfilling material shall consist of 2,000-psi cured compressive-strength concrete poured or pressure-grouted up to the level of the footing.

Vertical downspouts; soil, waste, and vent stacks; water risers; and similar work shall be properly supported on approved piers at the base and provided with approved structural supports attached to building construction.

Cleanout, flushing, and observation risers shall be provided.

3.9 DISINFECTION

Water piping, including all valves, fittings, and other devices, shall be disinfected with a solution of chlorine and water. Solution shall contain not less than 50 parts per million (ppm) of available chlorine. Solution shall be held for a period of not less than 8 hours, after which the solution shall contain not less than 10 ppm of available chlorine or the piping shall be redisinfected. After successful sterilization, the piping shall be thoroughly flushed before placing into service. Flushing shall be complete when the flush water contains less than 0.5 ppm of available chlorine. Contractor shall be responsible for approved disposal of contaminated flush water in accordance with written instructions received from the Environmental authority having jurisdiction through the Contracting Officer and all Local, State and Federal Regulations.

Piping shall be flushed with potable water until visible grease, dirt and other contaminants are removed (visual inspection).

3.10 OPERATION AND MAINTENANCE

Operation and Maintenance Manuals shall be consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions. Test data shall be clear and readily legible.

-- End of Section --

SECTION 15072

VIBRATION ISOLATION FOR AIR CONDITIONING EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S2.40	(1997; R 2001) Mechanical Vibration of Rotating and Reciprocating Machinery - Requirements for Measuring Vibration Severity
ANSI S3.29	(1996; R 2001) Evaluation of Human Exposure to Vibration in Buildings, Guide to

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE-02	(1999) Handbook, HVAC Applications (IP Edition)

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB Procedural Standards	(1994) Procedural Standards for Measuring Sound and Vibration

1.2 GENERAL REQUIREMENTS

Section 15003 GENERAL MECHANICAL PROVISIONS applies to work specified in this section to the extent applicable.

Section 15050 BASIC MECHANICAL MATERIALS AND METHODS applies to work specified in this section to the extent applicable.

All vibration-control apparatus shall be the product of a single manufacturing source, where possible. Human exposure levels should be considered using ANSI S3.29 and NEBB Procedural Standards.

Scheduled isolation mounting is in inches and is a minimum static deflection.

Spans referred to in Part 2, "Vibration-Isolation Systems Application," shall mean longest bay dimension.

Exact mounting sizes and number of isolators shall be determined by the isolator manufacturer based on equipment that will be installed. Equipment revolutions per minute (rpm) and spring deflections shall be checked to verify that resonance cannot occur.

Installation Drawings for vibration isolator systems shall include equipment and performance requirements.

Outline Drawings for vibration isolator systems shall indicate overall physical features, dimensions, ratings, service requirements, and weights of equipment.

Equipment and Performance Data for vibration isolator systems shall include equipment base design; inertia-block mass relative to support equipment weight; spring loads and free, operating, and solid heights of spring; spring diameters; nonmetallic isolator loading and deflection; disturbing frequency; natural frequency of mounts; deflection of working member; and anticipated amount of physical movement at the reference points.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings and Outline Drawings shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

SD-03 Product Data

Equipment and Performance Data shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

Manufacturer's catalog data shall be submitted for the following items:

Mountings
Bases
Isolators
Floor-Mounted Piping
Vertical Piping

SD-06 Test Reports

Test reports shall be submitted for deflection tests in accordance with the paragraph entitled, "Type of Vibration-Isolation Provisions," of this section. Reports shall include the following information:

Type of Isolator
Type of Base
Allowable Deflection
Measured Deflection

PART 2 PRODUCTS

2.1 TYPE OF VIBRATION-ISOLATION PROVISIONS

Design for vibration isolation using NEBB Procedural Standards and ASHRAE-02, Chapter 42, as applicable to the following sections.

Test reports for deflection tests shall be submitted for each Type of Isolator and each Type of Base, and meet referenced standards contained

within this section. Test reports shall also include Allowable Deflection and Measured Deflection also meeting referenced standards within this section.

2.1.1 Materials

Rubber shall be natural rubber. Elastomer shall be chloroprene. Shore A durometer measurement of both materials shall range between 40 and 60.

Inorganic materials such as precompressed, high-density, fibrous glass encased in a resilient moisture-impervious membrane may be used in lieu of specified natural rubber and elastomers. Where this substitution is made, specified deflections shall be modified by the manufacturing source to accommodate physical characteristics of inorganic materials and to provide equal or better vibration isolation.

Weather-exposed metal vibration-isolator parts shall be corrosion protected. Springs shall be chloroprene coated.

2.1.2 Mountings

Mountings shall be:

Type A: Composite pad, with 0.25-inch thick elastomer top and bottom layers, molded to contain a pattern with nonslip characteristics in all horizontal directions. Elastomer loading shall not exceed 40 pounds per square inch (psi). Minimum overall thickness shall be 1 inch. Maximum deflections up to 0.25-inch are allowed.

Type B: Double rubber-in-shear elastomer-in-shear with molded-in steel reinforcement in top and bottom. Maximum deflections up to 0.50 inch are allowed.

Type F: Combination spring and rubber-in-shear elastomer-in-shear steel framed for hanger-rod mounting. Minimum total static deflection shall be 1 inch.

2.1.3 Bases

Bases shall be:

Type U: Unit isolators without rails, structural-steel bases, or inertia blocks.

Type R: Rails, connected mill-rolled structural steel, of sufficient dimension to preclude deflection at midpoint of unsupported span in excess of 1/1,440th of the span between isolators, power transmission, component misalignment, and any overhung weight. Where Type R bases are specified and the equipment proposed requires additional base support, a Type S base shall be used.

Type S: Structural-steel bases common to a supported assembly, made from welded-joint mill-rolled structural steel with closed-perimeter configuration, isolators attached to outrigger supports.

Height of steel members shall be sufficient to provide stiffness required to maintain equipment manufacturer's recommended alignment and duty efficiency of power-transmission components. Height of steel member shall not result in member deflection at midpoint of unsupported

span of more than 1/1,440th of the span between isolators. Minimum height shall be 5 inches.

2.2 VIBRATION-ISOLATION SYSTEMS APPLICATION

Vibration isolation design per NEBB Procedural Standards ASHRAE-02, Chapter 42, ANSI S2.40.

2.2.1 Centrifugal Pump Locations

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
Seperatly-couple through 5 hp	None	-R-0.35	C-S-1.0	C-S-1.0
Bedplate-mounted through 5 hp	None	C-CIB-1.0	C-CIB-1.5	C-CIB-1.75

*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES

2.2.2 Air-Moving Device Locations

Vibration-isolation provisions apply to housed free-standing fans of any pressure rating, located in factory-fabricated central-station units.

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
Through 20 hp 200 to 300 rpm	B-U-0.35	C-S-2.5	C-S-2.5	C-S-3.5
300 to 500 rpm	B-U-0.35	C-S-1.75	C-S-1.75	C-S-2.5
500 rpm and over	B-U-0.35	C-S-1.0	C-S-1.5	C-S-1.75
Over 20 hp 250 to 300 rpm	B-U-0.35	C-S-2.75	C-CIB-3.5	C-CIB-5.0
300 to 500 rpm	B-U-0.35	C-S-1.75	C-CIB-2.5	C-CIB-3.5
500 rpm and over	B-U-0.35	C-S-1.0	C-CIB-1.75	C-CIB-2.5

*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES

2.3 PIPE AND DUCT VIBRATION ISOLATION

Type G: Isolators shall be devices with in-series contained steel springs and preformed fibrous-glass or chloroprene-elastomer elements for connecting to building-structure attachments. Devices shall be loaded by supported system during operating conditions to produce a minimum spring and elastomer static deflection of 1 inch and 3/8 inch, respectively.

Type H: Isolators shall be devices with contained chloroprene-elastomer elements for connecting to building-structure attachments. Devices shall be loaded by supported system during operating conditions to produce a minimum elastomer static deflection of 3/8 inch.

Type J: Isolators shall be devices with elastomers mounted on floor-supported columns or directly on the floor. Devices shall be loaded by supported system during operating conditions to produce a minimum elastomer static deflection of 3/8 inch.

2.3.1 Floor-Mounted Piping

Type K: Isolators shall be devices with springs mounted on floor-supported columns or directly on the floor. Devices shall be loaded by supported system during operating conditions to produce a minimum spring static deflection of 1 inch.

2.3.2 Vertical Piping

Type L: Isolators shall be pipe base-support devices with one or more contained steel springs. Devices shall be loaded by supported system during operating conditions to produce a minimum static deflection of 1 inch. Devices shall be equipped with precompression and vertical-limit features, as well as a minimum 1/4-inch thick elastomer sound pad and isolation washers, for mounting to floor.

Type M: Isolators shall be elastomer mounted baseplate and riser pipe-guide devices. Elastomer elements shall be contained double acting, and elastomers under rated load shall have a minimum static deflection of 3/8 inch. Isolator shall be sized to accommodate thermal insulation within the stationary guide ring.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed in accordance with manufacturer's recommendations.

Rails, structural steel bases, and concrete inertia blocks shall be raised not less than 1 inch above the floor and shall be level when equipment supported is under operating load.

3.2 TESTS AND REPORTS

Vibration-isolation devices shall be deflection tested. Test reports shall be submitted in accordance with paragraph entitled, "Submittal Procedures," substantiating that all equipment has been isolated as specified and that minimum specified deflections have been met. All measurements shall be made in the presence of the Engineer or Owner's Representative.

-- End of Section --

SECTION 15080

MECHANICAL INSULATION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 240/A 240M	(2004ae1) Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels for General Applications
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C 195	(1995) Mineral Fiber Thermal Insulating Cement
ASTM C 553	(1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 612	(2004) Mineral Fiber Block and Board Thermal Insulation
ASTM C 916	(1985; R 1990) Adhesives for Duct Thermal Insulation
ASTM C 1136	(2003a) Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials

MILITARY SPECIFICATIONS (MIL)

MIL-A-3316	(Rev. C; Am. 2) Adhesives, Fire-Resistant, Thermal Insulation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 255	(2000) Method of Test of Surface Burning Characteristics of Building Materials

UNDERWRITERS LABORATORIES INC. (UL)

UL 723	(2003) Test for Surface Burning Characteristics of Building Materials

1.2 QUALITY ASSURANCE

Provide new field-applied insulation for heating, ventilating, and cooling (HVAC) air distribution systems and piping systems which are located within, on, under, and adjacent to buildings; and for plumbing systems.

1.2.1 Packaging and Labeling

Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to project site shall have manufacturer's stamp or label attached giving name of manufacturer, brand and description of material. Insulation packages and containers shall be asbestos-free.

1.2.2 Surface Burning Characteristics

Materials shall have a flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50, when tested in accordance with NFPA 255, ASTM E 84 or UL 723. Insulation materials located exterior to the bilding perimeter are not required to be fire-rated.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittal Procedures".

SD-03 Product Data

Duct insulation

Duct insulation jackets

Piping insulation

Piping insulation jackets

Adhesives

Submit MSDS highlighting VOC content for each filed-applied adhesive used in the building interior.

1.4 RECYCLED MATERIALS

Provide thermal insulation containing recycled materials to the extent practicable, provided that the materials meets all other requirements of this section. The minimum recycled material content of the following insulation are:

Rock Wool - 75 percent slag by weight
Fiberglass - 20-25 percent glass cullet by weight
Phenolic Rigid Foam - 5 percent recovered material
Plastic Rigid Foam - 9 percent recovered material
Polyiscocyanurate/Polyurethane - 9 percent recovered material
Rigid Foam - 9 percent recovered material

PART 2 PRODUCTS

2.1 PIPING INSULATION

Insulation material shall conform to Table 1. Insulation thickness shall be as listed in Table 2. Except for flexible cellular insulation on equipment as specified in Table 2. Insulation exterior shall be factory cleanable, grease resistant, non-flaking and non-peeling. Refer to pipe insulation schedule for additional information.

2.1.1 Piping Insulation Jackets

2.1.1.1 All-Purpose Jacket

Provide insulation with insulation manufacturer's standard reinforced fire retardant jacket with or without integral vapor barrier as required by the service. Provide jackets in exposed locations with a white surface suitable for field painting.

2.1.1.2 Metal Jackets

a. Aluminum Jackets: ASTM B 209, Temper H14, minimum thickness of 27 gage (0.016 inch), with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside diameters less than 8 inches. Provide corrugated surface jackets for jacket outside diameters 8 inches and larger. Provide stainless steel bands, minimum width of 0.5 inch. Provide factory prefabricated aluminum covers for insulation on fittings, valves, and flanges. Covers shall be same thickness and material as jackets on adjacent piping.

b. Stainless Steel Jackets: ASTM A 167 or ASTM A 240/A 240M; Type 304, minimum thickness of 33 gage (0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 0.5 inch. Provide factory prefabricated stainless steel covers for insulation on fittings, valves, and flanges. Covers shall be same thickness and material as jackets on adjacent piping.

2.2 HEATING, VENTILATING, AND AIR CONDITIONING SYSTEMS INSULATION

2.2.1 Duct Insulation

Provide factory-applied insulation with insulation manufacturer's standard reinforced fire-retardant vapor barrier jacket, with identification of installed thermal resistance (R) value and out-of-package R value.

2.2.1.1 Rigid Insulation

Rigid mineral fiber in accordance with ASTM C 612, Class 2 (maximum surface temperature 400 degrees F), 3 pcf average, two inch thick or as indicated on the drawings.

2.2.1.2 Blanket Insulation

Blanket flexible mineral fiber insulation conforming to ASTM C 553, Type 1, Class B-3, 3/4 pound per cubic foot (pcf) nominal, 2.0 inches thick.

2.2.2 Duct Insulation Jackets

2.2.2.1 All-Purpose Jacket (ASJ)

Provide insulation with insulation manufacturer's standard reinforced fire-retardant jacket with integral vapor barrier as required by the service. In exposed locations, provide jacket with a white surface suitable for field painting.

2.2.2.2 Metal Jackets

a. Aluminum Jackets: ASTM B 209, Temper H14, minimum thickness of 27 gage (0.016 inch), with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside dimension 8 inches and smaller. Provide corrugated surface jackets for jacket outside dimension 8 inches and larger. Provide stainless steel bands, minimum width of 0.5 inch.

2.3 EQUIPMENT

Insulate equipment and accessories as indicated on the drawings. In outside locations, provide insulation 1/2 inch thicker than specified. Increase the specified insulation thickness for equipment where necessary to equal the thickness of angles or other structural members to make a smooth, exterior surface.

2.4 ADHESIVES, SEALANTS, AND COATING COMPOUNDS

2.4.1 Insulation and Vapor Barrier Adhesive

Provide ASTM C 916, Type I adhesive for securing insulation to metal surfaces and for vapor barrier lap only in building interior.

Adhesive shall have a VOC content not more than 70 g/l.

2.4.2 Lagging Adhesive

MIL-A-3316, Class 1, for bonding fibrous glass cloth to unfaced fibrous glass insulation; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bounding fibrous glass tape to joints of fibrous glass board; or for bonding lagging cloth to thermal insulation, or Class 2, for attaching fibrous glass insulation to metal surfaces. Provide for pipe and duct insulation.

Adhesive shall have a VOC content not more than 70 g/l.

2.4.3 Mineral Fiber Insulation Cement

ASTM C 195.

2.4.4 Vapor Barrier Coating

Provide in accordance with insulation manufacturers' recommendations.

2.5 ACCESSORY MATERIALS

2.5.1 Staples

ASTM A 167, Type 304 or 316 stainless steel outside-clinch type.

2.5.2 Insulation Bands

1/2 inch wide; 26 gage stainless steel.

2.5.3 Metal Bands

3/8 inch minimum width; 24 gage aluminum.

2.5.4 Anchor Pins and Speed Washers

Provide in accordance with insulation manufacturer's recommendations.

2.5.5 Fibrous Glass Cloth and Tape

Fibrous glass cloth and tape; 20 by 20 maximum size mesh. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces per square yard. In lieu of glass cloth and tape, open weave glass membrane may be provided.

2.5.6 Wire

Soft annealed stainless steel, 18 gage.

2.5.7 PVC Pipe Fitting Cover and Its Vapor Barrier Tape

Provide PVC fitting covers with insulation inserts of same material and thickness as pipe insulation.

2.5.8 Vapor Barrier Materials

ASTM C 1136. Resistant to flame, moisture penetration, and mold growth, color white.

PART 3 EXECUTION

3.1 PREPARATION

Clean and test mechanical systems prior to application of insulation. Obtain Owner's Representative's written approval of HVAC, water distribution systems, and air distribution systems under Section 15950, "HVAC Testing/Adjusting/Balancing" before applying field-applied insulation to mechanical systems. Do not insulate the following:

a. Adjacent insulation;

b. ASME stamps;

c. Access plates of fan housings;

d. Cleanouts or handholes;

e. Components within factory preinsulated HVAC equipment;

f. Factory preinsulated flexible ductwork;

g. Factory preinsulated HVAC equipment;

h. Manufacturer's nameplates;

i. Chrome plated pipes, and fire protection pipes;

j. Vibration isolating connections;

3.2 DUCTWORK, PLENUMS, CASINGS, AND ACCESSORIES INSULATION

Provide rigid type duct insulation in mechanical rooms and where indicated; provide blanket type insulation in all other locations. Provide field-applied insulation to exterior of supply ducts, outside air intake ducts, duct plenums, and casings of HVAC units. Ensure full range of motion of equipment actuators. Modify insulation to avoid obstruction with valve handles, safety reliefs, and other such items. Install insulation with jackets drawn tight and cement down on longitudinal and end laps. Do not use scrap pieces where a full length section will fit. Refer to duct construction and insulation schedule for information. Foil tape all seams/pins.

3.2.1 Rigid Insulation

Secure rigid insulation by impaling over pins or anchors located not more than 3 inches from joint edges of boards, spaced not more than 12 inches o.c. and secure with washers and clips. Spot weld anchor pins or attach with a waterproof adhesive especially designed for use on metal surfaces. Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors. Each pin or anchor shall be capable of supporting a 20 pound load. Cut off protruding ends of pins, after clips are sealed with coating compound for inside work or manufacturer's recommended weatherproof coating for outside work, and reinforced with open weave glass membrane. Foil tape all seams/pins.

3.2.2 Flexible Blanket Insulation

Apply insulation with joints tightly butted. Secure insulation to ductwork with adhesive in 6 inch wide strips on 12 inch centers. Staple laps of jacket with outward clinching staples on 4 inch centers. Sealing shall be in accordance with paragraph entitled "Insulation Finishes and Joint Sealing." Provide pins, washers and clips at 18 inches on center and not more than 4 inches from duct edge for duct surfaces greater than 24 inches across except for top surfaces of horizontal ducts. For vertical ducts with surfaces less than 24 inches across, provide pins no more than 4 inches from duct edge at 18 inches on center. Carry insulation over standing seams and trapeze-type hangers. Install speed washers with pins and pin trimmed to washer. Sagging of flexible duct insulation shall not be permitted. Cut off protruding ends of pins after securing and sealing clips with coating compound for inside work. For warm air ducts, overlap insulation not less than 2 inches at joints and secure laps with outward clinch staples on 4 inch centers. In cold air ducts, vapor seal joints and staple as specified.

3.2.3 Duct Sleeves and Pipe Sleeves

Insulation shall be continuous through sleeves, wall and ceiling openings, except at fire dampers in duct systems. Extend surface finishes to protect surfaces, ends, and raw edges of insulation. Apply coatings and adhesives

at manufacturer's recommended coverage per gallon.

3.2.4 Access Plates and Doors

On acoustically lined ducts, plenums, and casings, provide insulation on access plates and doors. On externally insulated ducts, plenums, and casings, bevel insulation around access plates and doors.

3.2.5 Insulation Finishes and Joint Sealing

Fill breaks, punctures, and voids with vapor barrier coating compound for inside work or manufacturer's recommended weatherproof coating for outside work. Vapor seal joints by embedding a single layer of 3 inch wide open weave glass membrane, maximum 20 by 20 mesh per linear one inch between two 1/16 inch wet film thickness coats of vapor barrier coating compound. Draw glass fabric smooth and tight with a 1 1/2 inch overlap. At jacket penetrations such as hangers, thermometers, and damper operating rods, fill voids in insulation with vapor barrier coating. Brush a coat of vapor barrier coating where required on HVAC ducts. Provide vapor barrier jacket continuous across seams, reinforcements, and projections. Where height of projections is greater than insulation thickness, carry insulation and jacket over projection. For joints for heating only systems, provide insulation with two coats of fire resistant adhesive with glass fabric mesh embedded between coats.

3.2.6 Moisture Seal

Provide a vapor (moisture) seal where insulation terminates against metal hangers, anchors and other projections through insulation on surfaces for which a vapor seal is specified. Keep insulation dry during application of finish. Bevel and seal edges of exposed insulation.

3.3 PIPE INSULATION

3.3.1 Pipe Insulation (Except Cellular and Calcium Silicate Insulation)

Place sections of insulation around pipe and joints tightly butted into place. Draw jacket tight and smooth. Secure jacket with fire resistant adhesive, factory-applied self-sealing lap, or stainless steel outward clinching staples spaced not over 4 inches on center (o.c.) and 1/2 inch minimum from edge of lap. Cover circumferential joints with butt strips, not less than 3 inches wide, of material identical to jacket material. Overlap longitudinal laps of jacket material not less than 1 1/2 inches. Adhesive used to secure butt strip shall be same as that used to secure jacket laps. Apply staples to both edges of butt strips.

a. Vapor Barrier Jacket: When a vapor barrier jacket is required, as indicated in Table 1, on ends of sections of insulation that butt against flanges, unions, valves, fittings, and joints, provide a vapor barrier coating or manufacturer's weatherproof coating for outside service unless pipe is supplied with factory-applied self-seal lap. Apply vapor barrier coating at longitudinal and circumferential laps. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing, stapling, and coating as specified for butt strips. Extend patch not less than 1 1/2 inches past the break in both directions. At penetrations by pressure gages and thermometers, fill voids with vapor barrier coating for outside service. Seal with a brush coat of the same coating. Do not use staples to secure jacket laps on

pipes carrying fluid medium at temperatures below 35 degrees F.

b. Roof: Where pipe penetrates, insulate piping to a point flush with top of flashing and seal with vapor barrier coating. Butt top of flashing and interior insulation tightly to exterior insulation. Extend exterior metal jacket 2 inches to fold down beyond end of insulation. Seal flashing and counterflashing underneath with vapor barrier coating.

3.3.2 Flexible Cellular Insulation

Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90-degree turns and elbows, tees, and valve insulation. Where pipes penetrate fire walls, provide mineral-fiber insulation inserts and sheet-metal sleeves. Insulate flanges, unions, valves, and fittings in accordance with manufacturer's published instructions. Apply two coats of finish as recommended by insulation manufacturers to flexible unicellular insulation in outside locations. Do not use vinyl lacquer finish or equivalent. Use metal jackets on cellular insulation located outside.

3.3.3 Cellular Glass and Calcium Silicate Insulation

Provide in accordance with manufacturer's printed instructions.

3.3.4 Hangers and Anchors

Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by insulation, provide galvanized steel shields and protection saddles. Where shields are used on pipes 2 inches and larger, provide insulation inserts at points of hangers and supports. Insulation inserts shall be of calcium silicate, cellular glass, minimum 8 pcf, molded glass fiber, minimum 8 pcf, or other approved material of the same thickness as adjacent insulation. Insulation inserts shall cover bottom half of pipe circumference and be not less in length than the protection shield. Vapor-barrier facing of insert shall be of same material as facing on adjacent insulation. Seal inserts into insulation with vapor barrier coating or weatherproof coating as applicable. Where protection saddles are used, fill voids with same insulation material as used on adjacent pipe. Where anchors are secured to chilled piping that is to be insulated, insulate anchors same as piping for a distance not less than four times the insulation thickness to prevent condensation. Vapor seal insulation around anchors.

3.3.5 Sleeves and Wall Chases

Where interior wall penetrates, extend an aluminum jacket 2 inches out on either side of wall and secure on each end with a band. Where floor penetrates, extend a metal jacket from a point below back-up material to a point 10 inches above floor with one band at the floor and one not more than one inchfrom end of metal jacket. Where exterior wall is penetrated, extend metal jacket through sleeve to a point 2 inches beyond interior surface of wall.

3.3.6 Flanges, Unions, Valves and Fittings for Piping

Provide insulation for cold piping and hot piping of 110 degrees F or higher. Factory fabricated removable and reusable insulation covers may be used except with flexible cellular. When nesting size insulation is used, overlap 2 inches or one pipe diameter, whichever is larger. Use insulating

cement to fill voids. On pipe sizes larger than 2 1/2 inches, elbows insulated using segments shall not have less than three segments per elbow. Place and joint segments with manufacturer's recommended water-vapor resistant, fire retardant, and adhesive appropriate for the temperature limit of the service. Overlap tape seams one inch. Extend adhesive onto adjoining insulation not less than two inches. Total dry film thickness shall not be less than 1/16 inch. Where unions are indicated not to be insulated, taper insulation to union at a 45 degree angle. Provide finish coating as follows:

a. Coating with Embedded Glass Tape: Coat insulation and all purpose jacket with two coats of lagging adhesive and with glass tape embedded between coats. Total dry film thickness shall not be less than 1/16 inch. Where unions are indicated not to be insulated, taper insulation to union at a 45 degree angle. For cold piping, seal insulation and jacket with two coats of vapor barrier coating with glass tape embedded between coats. Insulate anchors attached directly to cold pipe for a sufficient distance to prevent condensation but not less than 6 inches from insulation surface.

b. PVC Fitting Covers: Factory premolded one-piece PVC fitting covers may be provided in lieu of two coats of adhesive with tape embedded between coats. Provide factory premolded field-fabricated segment or blanket insert insulation under fitting covers. Install factory premolded one-piece PVC fitting covers over insulation. Secure covers with stapling, taping with PVC vapor barrier tape, or with metal or plastic tacks made for securing PVC fitting covers. Do not provide PVC fitting covers where exposed to weather. Provide PVC fitting covers only in ambient temperatures below 150 degrees F.

3.3.7 Piping Exposed to Weather

3.3.7.1 Metal Jackets

Provide over insulation. Machine cut jacket to smooth edge of circumferential joints. Overlap jacket not less than 2 inches at longitudinal and circumferential joints and secure with metal bands at not more than 9 inch centers. Overlap longitudinal joints down to shed water. Seal joints with a coating recommended by insulation manufacturer for weatherproofing.

3.3.7.2 Flanges, Unions, Valves, Fittings, and Accessories

Insulate and finish as specified hereinbefore for applicable service. Apply two coats of an emulsion type weatherproof mastic for hot service and vapor barrier mastic for cold service recommended by insulation manufacturer. Embed glass tape in the first coat. Overlap tape not less than one inch and the adjoining metal jacket not less than 2 inches.

3.4 EQUIPMENT INSULATION

Apply equipment insulation suitable for temperature and service in rigid block or semi-rigid board or flexible form to fit as closely as possible to equipment. Groove or score insulation where necessary to fit contours of equipment. Stagger end joints where possible. Bevel edges of insulation for cylindrical surfaces to provide tight joints. Join sections of cellular glass insulation with bedding compound. After cellular glass

insulation is in place on areas to be insulated, except where metal-encased, fill joints, seams, chipped edges, or depressions with bedding compound to form a smooth surface. Fill mineral fiber joints with insulating cement. Bevel insulation around name plates, ASME and access plates. For insulation on equipment that is opened periodically for inspection, cleaning, or repair, construct insulation to be removable and replaceable without damage. Protect exposed insulation corners with corner angles under wires and bands.

3.4.1 Geothermal Equipment (Except Pumps)

Air separators, expansion tanks secure insulation with 16 gage, galvanized steel or copper clad wire or with 3/4 inch wide 20 gage stainless steel bands spaced on 12 inch centers. Seal joints with joint sealer. Cover non-removable irregular surfaces such as corner angles with a smoothing coat of insulating cement. Apply two coats of vapor barrier coating with a layer of glass cloth embedded between coats. Dry film thickness of finish shall be 1/32 inch minimum.

3.4.2 Pumps

Insulate pumps used for hot service with preformed mineral fiber insulation and pumps used for chilled water service with cellular glass or flexible cellular insulation. Insulate pumps by forming a box around pump housing, drive shaft, and piping. Apply insulation to inside surfaces of 20 gage galvanized sheet-metal boxes having openings for drive shaft and pipes. Construct box by forming bottom and sides using joints which do not leave raw ends of insulation exposed. Band bottom and sides to form a rigid housing that does not rest on pump. Between top cover and sides, fit joints tightly forming a female shiplap joint on side pieces and a male joint on top cover to make top cover removable. Secure insulation to box with adhesive. Allow clearance for draining and adjustment of pump shaft seal.

3.5 FIELD QUALITY CONTROL

Visually inspect to ensure that materials provided conform to specifications. Inspect installations progressively for compliance with requirements.

3.5.1 Air Distribution Systems

Obtain Owner's Representative's written approval of systems under Section 15950, "HVAC Testing/Adjusting/Balancing" before applying field insulation to air distribution systems.

3.5.2 Piping Systems

Obtain Owner's Representative's written approval of HVAC water distribution systems under Section 15950, "HVAC Testing/Adjusting/Balancing" before applying field-applied insulation to HVAC water distribution systems. At Contractor's option and with Owner's Representative's written approval, piping systems may be insulated before systems are tested, adjusted, and balanced (TAB'd). Piping insulation shall terminate immediately adjacent to each flow control valve, automatic control valve, or device. For chilled water and chilled-hot water piping systems, seal ends of pipe insulation and space between ends of pipe insulation and piping with waterproof vapor barrier seating. After systems are TAB'd, insulate control valves and devices.

TABLE 1
Insulation Material For Piping
REFER TO DRAWINGS

TABLE 2
Insulation Thickness for Equipment

Equipment	Thickness
Expansion Tanks	1/2"
Air Separators	2"
*Pumps	2"
*Hot Water Storage Tanks	2"
Hot Water Duct-Mounted Coils	2"
Chilled Water Tanks/Recycled Storage Tank 35oF to 55oF	1"

NOTE: * indicates where vapor barrier is required.

-- End of Section --

SECTION 15110

VALVES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose (Inch)
ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.34	(1996) Valves - Flanged, Threaded and Welding End

ASTM INTERNATIONAL (ASTM)

ASTM A 126/A 126M	(1995) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 216/A 216M	(2004) Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM B 61	(2002) Steam or Valve Bronze Castings
ASTM D 1784	(2003) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-67	(2002) Butterfly Valves

NSF INTERNATIONAL (NSF)

NSF 14	(2003) Plastics Piping System Components and Related Materials

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS WW-V-35	(Rev C) Valve, Ball

1.2 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings shall be submitted for the following in accordance with pargraph entitled, "General Requirements," of this section.

Valves
Accessories

Installation drawings for valves shall be in accordance with the paragraph entitled, "Installation," of this section.

SD-03 Product Data

Bonding Adhesive

Submit MSDS highlighting VOC content for each filed-applied adhesive used in the building interior.

1.3 GENERAL REQUIREMENTS

Section 15003 GENERAL MECHANICAL PROVISIONS applies to work specified in this section.

Fabrication Drawings shall be submitted for each type of Valves and Accessories used, meeting referenced standards contained within this section.

Listing of Product Installation shall be submitted for valve assemblies indicating at least five installed units, similar to those proposed for use, that have been in successful service for a minimum of five years.

PART 2 PRODUCTS

2.1 COMPONENTS

2.2 FABRICATION

2.2.1 Check Valves, spring Loaded, Silent lift Disc

2.2.1.1 350 psi

Valves shall be rated 300-psi wsp and shall conform to applicable portions of ASME B16.34.

Valves shall be horizontal silent lift disc type.

Body end connections shall be flanged for all valves larger than 2 inches unless butt weld ends are specified. Screwed weld shall be used for sizes 2 inches and under to suit specified piping system end connection and maintenance requirements. Flange faces shall have concentric serrated finish.

Body to cover connection shall be gasketed-bolted type.

Body and bonnet assembly shall be cast steel for 2" and larger and bronze for less then 2". Cast steel shall conform to ASTM A 216/A 216M, Grade WCB.

Trim materials, including hinge pin, shall be manufacturer's standard

corrosion-resistant alloys for the specified service.

2.2.2 CONE-PLUG BALANCING VALVE

Cone-plug balancing valves in sizes through 1-1/4 inchesshall be thread end, conforming to ASME B1.20.1 and shall be rated for service at not less than 175 psi at 250 degrees F. Valve body and components shall be ASTM B 61 bronze. Valve plug shall be swivel-type contoured cone and shall not rattle or make noise in service at any balancing position. Valve shall have high temperature, service-rated packing, with bushing in bottom of gland and gland adjustment. Valves shall be fitted with a memory device which shall permit a valve set at a balance point to be opened or closed but not opened beyond the balance point. Valve shall be nonrising stem type. Where used for combination shutoff and balancing service, valve shall be furnished with insulating composition handle.

2.2.3 Ball Valves

Ball valves shall conform to FS WW-V-35. Valves shall be 2 piece/full port.

Valves shall be rated for service at not less than 175 psi at 200 degrees F.

Valve bodies in sizes 2-inch ips and smaller shall be screwed-end-connection type, constructed of Class A copper alloy.

Valve bodies in sizes 2-1/2-inch ips and larger shall be flanged-end connection type, constructed of Class bronze body.

Balls and stems of valves 2-inch ips and smaller shall be Class C corrosion-resistant steel alloy with hard-chrome plate. Electroless nickel plating is acceptable.

Balls and stems of valves 2-1/2-inch ips and larger shall be manufacturer's standard Class C, corrosion-resistant steel alloy with hard-chrome plate. In valves 6-inch ips and larger, balls shall be Class D with 900 Brinell hard-chrome plate. Electroless nickel-plating is acceptable.

Valves shall be suitable for flow from either direction and shall seal equally tight in either direction.

Valves shall have full-pipe-size flow areas.

Valves with ball seals kept in place by spring washers are not acceptable. Valves shall have adjustable packing glands. Seats and seals shall be tetrafluoroethylene or PTFE.

Valve body construction shall be such that:

Torque from a pipe with a valve installed shall not tend to disassemble the valve by stripping setscrews or loosening body-end inserts or coupling nuts.

Torque from a pipe shall be resisted by a two-piece body between end connections.

2.2.3.1 Plastic, PVC

Ball valves shall be manufactured from a PVC compound that meets the requirements of Type 1, Grade 1 PVC as outlined in ASTM D 1784. Valves

shall also conform to NSF 14.

Valves shall have Teflon ball seals and Viton stem and body seals. Ball valves shall carry a pressure rating of 150-psi circulating water pressure (cwp) at 75 degrees F.

2.2.4 Butterfly Valves, Bubble Tight

2.2.4.1 Metal

Butterfly valves shall conform to MSS SP-67.

Butterfly valves shall be threaded lug bodies for dead end shutoff type for mounting between specified flanges and shall be rated for 200-psig shutoff and nonshock working pressure. Body shall be cast-ferrous metal, conforming to requirements of ASTM A 126/A 126M, Class B, and to ASME B16.1 for body wall thickness.

Face-to-face dimensions shall conform to MSS SP-67.

Valves installed in insulated piping systems shall be provided with extended bonnets placing the operator beyond the specified insulation.

Disk shall be free of external ribs and shall be streamlined. Disk shall be fabricated from cast ferrous alloys.

Use of taper pins to secure the valve disc to the shaft is prohibited.

Valve shall be rated for bubble tight operation.
Liner shall be composed of EPDM.
One peice stem only.

VALVE SIZE (INCH)	SHAFT DIAMETER (INCH)	VALVE SIZE (INCH)	SHAFT DIAMETER (INCH)
2-1/2	7/16	10	1-1/8
3	1/2	12	1-1/4
4	5/8	14	1-1/2
5	11/16	16	1-5/8
6	3/4	18	1-7/8
8	7/8	20	2-1/8

Seats and seals shall be resilient-elastomer type designed for field removal and replacement. Elastomers shall be Buna-N EPDM, formulated for continuous immersion service at 250 degrees F, minimum, and shall be applied at least 10 percent below maximum continuous service temperature. Bonding adhesives shall comply with elastomer temperature requirements and shall have an effective life equal to or greater than the elastomer.

Bonding adhesive shall have a VOC content not to exceed 70 g/l.

Seals on 20-inch and smaller valves shall be designed to use standard

split-V packing, dual O-rings, and quad rings.

Seat or disk matting surfaces shall be corrosion-resistant material such as austenitic gray cast iron and bronzes specified for the disk or the materials specified for stems. These materials shall be welded to substrate and ground. Plated or similarly applied surfacing materials are not acceptable.

Bearings shall be permanently lubricated sleeve type of manufacturer's standard corrosion-resistant steel. Bearings shall be designed for a pressure not exceeding the published design load for the bearing material. Operating end of the shaft shall be provided with dual inboard bearings in or beyond the operator.

Padlocking feature shall be provided to make valve tamperproof.

For balancing service, valve operators shall have provision for infinite position locking.

Manual nonchain-operated valves through 6 inches shall be provided with not less than nine-position, lever-lock handles not exceeding 18 inches in length.

Gear operators shall be worm-gear type. Operator shall be totally enclosed in a cast-iron housing, suitable for grease or oil lubrication. Gears shall be hobcut. Cast-iron-housed traveling-nut operators are acceptable MSS SP-67. Maximum manual pull on the handwheel or chain wheel shall be 80 pounds.

PART 3 EXECUTION

3.1 INSTALLATION

Valves shall be installed in accordance with the manufacturer's recommendations and in accordance with the applicable requirements of Section 15050 BASIC MECHANICAL MATERIALS AND METHODS.

-- End of Section --

SECTION 15181

HYDRONIC WATER PIPING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22	(1999; A 2001) Relief Valves for Hot Water Supply Systems

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992; R 2003) Specification for Filler Metals for Brazing and Braze Welding
AWS BRH	(2002) Brazing Handbook
AWS D1.1/D1.1M	(2004) Structural Welding Code-Steel
AWS Z49.1	(1999) Safety in Welding, Cutting and Allied Processes

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose (Inch)
ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.11	(2002) Forged Steel Fittings, Socket-Welding and Threaded
ASME B16.18	(1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2002) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions
ASME B16.9	(2003) Factory-Made Wrought Steel

	Buttwelding Fittings
ASME B31.9	(1996) Building Services Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME Z21.22	(1999; 2001) Relief Valves for Hot Water Supply Systems

ASTM INTERNATIONAL (ASTM)

ASTM A 53/A 53M	(2004a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 653/A 653M	(2001a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 733	(2003) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B 42	(1998) Seamless Copper Pipe, Standard Sizes
ASTM B 117	(2002) Operating Salt Spray (Fog) Apparatus
ASTM B 32	(2004) Solder Metal
ASTM B 62	(2002) Composition Bronze or Ounce Metal Castings
ASTM B 75	(2002) Seamless Copper Tube
ASTM B 813	(2000e1) Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B 88	(2003) Seamless Copper Water Tube
ASTM D 3308	(2001) PTFE Resin Skived Tape
ASTM D 520	(2000) Zinc Dust Pigment
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM F 1007	(1986; R 2002) Pipeline Expansion Joints of the Packed Slip Type for Marine Application
ASTM F 1199	(1988; R 2004) Cast (All Temperatures and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.5	(1994) Centrifugal Nomenclature

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(2002) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(2002) Pipe Hangers and Supports - Selection and Application
MSS SP-71	(1997) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-78	(1998) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2003; R 2004) Motors and Generators
NEMA MG 11	(1977; R 1997; R 2001) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
NFPA 90A	(2002) Installation of Air Conditioning and Ventilating Systems

1.2 SYSTEM DESCRIPTION

Provide the water systems having the minimum service (design) temperature-pressure rating indicated. Provision of the piping systems, including materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with the required and advisory provisions of ASME B31.9 except as modified or supplemented by this specification section or design drawings. This specification section covers the hydronic water systems (HVAC) piping which is located within, on, and adjacent to building(s) within the building(s) 5 foot line.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Calibrated Balancing Valves

Automatic Flow Control Valves

Pump Discharge Valve

Expansion Joints

Pumps

Combination Strainer and Pump Suction Diffuser

Expansion Tanks

Air Separator Tanks

Adhesives and Sealants

Submit MSDS highlighting VOC content for each filed-applied adhesive used in the building interior.

SD-06 Test Reports

Piping welds NDE report

Pressure tests reports

Report shall be provided in bound 8 1/2 by 11 inch booklets. In the reports, document all phases of the tests performed. Include initial test summaries, all repairs/adjustments made, and the final test results.

SD-07 Certificates

Employer's Record Documents (For Welding)

Welding Procedures and Qualifications

Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Fittings
Unions
Flanges
Gaskets
Bolting

SD-10 Operation and Maintenance Data

Requirements for data packages are specified Section 01781 OPERATION AND MAINTENANCE DATA, except as supplemented and modified by this specification section.

Submit spare parts data for each different item of equipment specified, with operation and maintenance data packages. Include a complete list of parts and supplies, with current unit prices

and source of supply, a recommended spare parts list for 1 year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

Submit a list of qualified permanent service organizations with operation and maintenance data packages. Include service organization addresses and service area or expertise. The service organizations shall be reasonably convenient to the equipment installation and be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

Calibrated Balancing Valves, Data Package 3

Automatic Flow Control Valves, Data Package 3

Pump Discharge Valve, Data Package 2

Expansion Joints, Data Package 2

Pumps, Data Package 3

Combination Strainer and Pump Suction Diffuser, Data Package 2

Expansion Tanks, Data Package 2

Air Separator Tanks, Data Package 2

1.4 MODIFICATIONS TO REFERENCES

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Architect/Engineer firm.

1.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall."

1.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.5 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so

that proper operation of equipment is not impaired.

1.6 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, cap piping and similar openings to keep out dirt and other foreign matter. Any porous materials found to be contaminated with mold or mildew will be replaced at the Contractor's expense. Non-porous materials found to be contaminated with mold or mildew will be disinfected and cleaned prior to installation.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Owner's Representative of any discrepancy before performing any work.

1.7.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

1.7.3 Accessibility

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening, unless noted on the drawings.

The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures.

Products having less than a 2 year field service record shall be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. System components shall be environmentally suitable for the indicated locations.

The equipment items shall be supported by service organizations. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

2.2 STEEL PIPING

Water piping shall be steel pipe or copper tubing. Provide steel piping with a ANSI/ASME Class 125 service rating, which for 150 degrees F, the pressure rating is 175 psig.

2.2.1 Pipe

Steel pipe, conform to ASTM A 53/A 53M, Schedule 40, Type E or S, Grades A or B. Do not use Type F pipe.

2.2.2 Fittings and End Connections (Joints)

Piping and fittings 1 inch and smaller shall have threaded connections. Piping and fittings larger than 1 inch and smaller than 3 inches shall have either threaded or welded connections. Piping and fittings 3 inches and larger shall have welded or flanged connections. The manufacturer of each fitting shall be permanently identified on the body of the fitting in accordance with MSS SP-25.

2.2.2.1 Threaded Connections

Use threaded valves and pipe connections conforming to ASME B1.20.1. Used threaded fitting conforming to ASME B16.3. Use threaded unions conforming to ASME B16.39. Use threaded pipe nipples conforming to ASTM A 733.

2.2.2.2 Flanged Connections

Flanges shall conform to ASME B16.1, Class 150. Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full face or self-centering flat ring type. These gaskets shall contain aramid fibers bonded with styrene butadeine rubber (SBR) or nitrile butadeine rubber (NBR). Bolts, nuts, and bolt patterns shall conform to ASME B16.1.

2.2.2.3 Welded Connections

Welded valves and pipe connections (both butt-welds and socket-welds types) shall conform to ASME B31.9. Butt-welded fittings shall conform to ASME B16.9. Socket-welded fittings shall conform to ASME B16.11. Welded fittings shall be identified with the appropriate grade and marking symbol.

2.2.2.4 Dielectric Waterways and Flanges

Provide dielectric waterways with a water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint. When dry, insulation barrier shall be able to withstand a 600-volt breakdown test. Provide dielectric waterways constructed of galvanized steel and have threaded end connections to match connecting piping. Dielectric waterways shall be suitable for the required operating pressures and temperatures. Provide dielectric flanges with the same pressure ratings as standard flanges and provide complete electrical isolation between connecting pipe and/or equipment as described herein for

dielectric waterways.

2.3 COPPER TUBING

Provide copper tubing and fittings with a ANSI/ASME Class 125 service rating, which for 150 degrees F., the pressure rating is 175 psig.

2.3.1 Tube

Use copper tube conforming to ASTM B 88, Type L or M for aboveground tubing.

2.3.2 Fittings and End Connections (Solder and Flared Joints)

Wrought copper and bronze solder joint pressure fittings, including unions ands flanges, shall conform to ASME B16.22 and ASTM B 75. Provide adapters as required. Cast copper alloy solder-joint pressure fittings , including unions and flanges, shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. ASTM B 42 copper pipe nipples with threaded end connections shall conform to ASTM B 42.

Copper tubing of sizes larger than 4 inches shall have brazed joints.Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment.

Extracted brazed tee joints may be used if produced with an acceptable tool and installed in accordance with tool manufacturer's written procedures.

2.3.3 Solder

Provide solder in conformance with ASTM B 32, grade Sb5, tin-antimony alloy. Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B 813.

2.3.4 Brazing Filler Metal

Filler metal shall conform to AWS A5.8, Type BAg-5 with AWS Type 3 flux, except Type BCuP-5 or BCuP-6 may be used for brazing copper-to-copper joints.

2.4 VALVES

Refer to Section 15110 for additional information.

Provide valves with a ANSI/ASME Class 125 service rating, which for 150 degrees F, the pressure rating is 175 psig.

Valves in sizes larger than 1 inch and used on steel pipe systems, may be provided with rigid grooved mechanical joint ends. Such grooved end valves shall be subject to the same requirements as rigid grooved mechanical joints and fittings and, shall be furnished by the same manufacturer as the grooved pipe joint and fitting system.

2.4.1 Check Valve

Check valves 2-1/2 inches and smaller shall conform to MSS SP-80. Check valves 3 inches and larger shall conform to MSS SP-71, Class 125.

2.4.2 Plug Valve

Plug valves 2 inches and larger shall conform to MSS SP-78, have flanged or threaded ends, and have cast iron bodies with bronze trim. Valves 2 inches and smaller shall be bronze with NPT connections for black steel pipe and brazed connections for copper tubing. Valve shall be lubricated, non-lubricated, or tetrafluoroethylene resin-coated type. Valve shall be resilient, double seated, trunnion mounted with tapered lift plug capable of 2-way shutoff. Valve shall operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug. Valve shall a weatherproof operators with mechanical position indicators. Valves 8 inches or larger shall be provided with manual gear operators with position indicators.

2.4.3 Ball Valve

Full port design. Ball valves 1/2 inch and larger shall conform to MSS SP-72 or MSS SP-110 and shall be cast iron or bronze with threaded, soldered, or flanged ends. Valves 8 inches or larger shall be provided with manual gear operators with position indicators. Ball valves may be provided in lieu of gate valves.

2.4.4 Square Head Cocks

Provide copper alloy or cast-iron body with copper alloy plugs, suitable for 125 psig water working pressure.

2.4.5 Calibrated Balancing Valves

Copper alloy or cast iron body, copper alloy or stainless internal working parts. Provide valve calibrated so that flow can be determined when the temperature and pressure differential across valve is known. Valve shall have an integral pointer which registers the degree of valve opening. Valve shall function as a service valve when in fully closed position. Valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation.

Provide valve bodies with tapped openings and pipe extensions with positive shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable differential pressure meter connections to verify the pressure differential. Provide metal tag on each valve showing the gallons per minute flow for each differential pressure reading.

2.4.6 Automatic Flow Control Valves

Valve shall automatically maintain the constant flow indicated on the design drawings. Valve shall modulate by sensing the pressure differential across the valve body. Valve shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Provide valve that controls the flow within 5 percent of the tag rating. Valve materials shall be the same as specified for the ball or plug valves.

Provide valve that are electric type as indicated. Valve shall be capable of positive shutoff against the system pump head, valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings and differential meter, suitable for the

operating pressure specified. Provide the meter complete with hoses, vent, integral metering connections, and carrying case as recommended by the valve manufacturer.

2.4.7 Pump Discharge Valve

Valve shall shall perform the functions of a nonslam check valve, a manual balancing valve, and a shutoff. Valve shall be of cast iron or ductile iron construction with bronze and/or stainless steel accessories. Provide an integral pointer on the valve which registers the degree of valve opening. Flow through the valve shall be manually adjustable from bubble tight shutoff to full flow. Valves smaller than 2 inches shall have NPT connections. Valves 2 inches and larger shall have flanged end connections. Valve design shall allow the back seat for the stem to be replaced in the field under full line pressure.

2.4.8 Pressure Relief Valve

Valve shall prevent excessive pressure in the piping system when the piping system reaches its maximum heat buildup. Valve, ANSI Z21.22 and shall have cast iron bodies with corrosion resistant internal working parts. The discharge pipe from the relief valve shall be the size of the valve outlet unless otherwise indicated.

2.4.9 Drain Valves

Valves, ball valves. Valve shall be manually-operated, 3/4 inch pipe size and above with a threaded end connection. Provide valve with a water hose nipple adapter. Freeze-proof type valves shall be provided in installations exposed to freezing temperatures.

2.4.10 Air Venting Valves

Manually-operated general service type air venting valves, brass or bronze valves that are furnished with threaded plugs or caps. Air venting valves on water coils shall have not less than 1/8 inch threaded end connections. Air venting valves on water mains shall have not less than 3/4 inch threaded end connections. Air venting valves on all other applications shall have not less than 1/2 inch threaded end connections.

2.4.11 Vacuum Relief Valves

ASME Z21.22

2.5 PIPING ACCESSORIES

2.5.1 Strainer

Strainer, ASTM F 1199, except as modified and supplemented in this specification. Strainer shall be the cleanable, basket or "Y" type, the same size as the pipeline. Strainer bodies shall be fabricated of cast iron with bottoms drilled, and tapped. Provide blowoff outlet with pipe nipple, gate valve, and discharge pipe nipple. The bodies shall have arrows clearly cast on the sides indicating the direction of flow.

Provide strainer with removable cover and sediment screen. The screen shall be made of minimum 22 gauge corrosion-resistant steel with small perforations numbering not less than 400 per square inch to provide a net free area through the basket of at least 3.30 times that of the entering

pipe. The flow shall be into the screen and out through the perforations.

2.5.2 Flexible Pipe Connectors

Provide flexible stainless steel piping connectors with single braid. Equip flanged assemblies with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Provide covers to protect the bellows where indicated.

2.5.3 Pressure and Vacuum Gauges

Gauges, ASME B40.1 with throttling type needle valve or a pulsation dampener and shut-off valve. Provide gauges with 4.5 inch dial, brass or aluminum case, bronze tube, and siphon. Gauge shall have a minimum of with a range from 0 psig to approximately 1.5 times the maximum system working pressure. Each gauge range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.

2.5.4 Temperature Gauges

Temperature gauges, shall be the industrial duty type and be provided for the required temperature range. Provide gauges with fixed thread connection, dial face gasketed within the case; and an accuracy within 2 percent of scale range. Gauges shall have Fahrenheit scale in 2 degree graduations scale (black numbers) on a white face. The pointer shall be adjustable. Rigid stem type temperature gauges shall be provided in thermal wells located within 5 feet of the finished floor. Universal adjustable angle type or remote element type temperature gauges shall be provided in thermal wells located 5 to 7 feet above the finished floor or in locations indicated. Remote element type temperature gauges shall be provided in thermal wells located 7 feet above the finished floor or in locations indicated.

2.5.4.1 Stem Cased-Glass

Stem cased-glass case shall be polished stainless steel or cast aluminum, 9 inches long, with clear acrylic lens, and non-mercury filled glass tube with indicating-fluid column.

2.5.4.2 Thermal Well

Thermal well shall be identical size, 1/2 or 3/4 inch NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 1/2 inch NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Mercury shall not be used in thermometers. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 1 inch.

2.5.5 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, guides, and supports: to MSS SP-58 and MSS SP-69.

2.5.6 Escutcheons

Provide one piece hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Secure plates in place by internal spring

tension or set screws. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces.

2.5.7 Expansion Joints

2.5.7.1 Slip-Tube Type

Slip-tube expansion joints, ASTM F 1007, Class I or II. Joints shall be provided with internally-externally alignment guides, injected semi-plastic packing, and service outlets. End connections shall be flanged or beveled for welding as indicated. Initial settings shall be made in accordance with the manufacturer's recommendations to compensate for ambient temperature at time of installation. Pipe alignment guides shall be installed as recommended by the joint manufacturer.

2.6 PUMPS - SEPARATELY COUPLED

Provide as scheduled and below.

Pumps shall be the electrically driven, non-overloading, centrifugal type which conform to HI 1.1-1.5. Pumps shall be selected at or within 5 percent of peak efficiency. Pump curve shall rise continuously from maximum capacity to shutoff. Pump motor shall conform to NEMA MG 1, be open splash-proof and have sufficient horsepower for the service required. Pump motor shall have the required capacity to prevent overloading with pump operating at any point on its characteristic curve. Pump speed shall not exceed 1,750 rpm. Pump motor shall be equipped with VFD controller, motor shall be rated for VFD operation. Match motor selection with VFD selection.

2.6.1 Construction

Each pump casing shall be designed to withstand the discharge head specified plus the static head on system plus 50 percent of the total, but not less than 125 psig. Pump casing and bearing housing shall be close grained cast iron. High points in the casing shall be provided with manual air vents; low points shall be provided with drain plugs. Provide threaded suction and discharge pressure gage tapping with square-head plugs.

Impeller shall be statically and dynamically balanced. Impeller, impeller wearing rings, glands, casing wear rings, and shaft sleeve shall be bronze. Shaft shall be carbon or alloy steel, turned and ground. Bearings shall be ball-bearings, roller-bearings, or oil-lubricated bronze-sleeve type bearings, and be efficiently sealed or isolated to prevent loss of oil or entrance of dirt or water.

Pump and motor shall be mounted on a common cast iron base having lipped edges and tapped drainage openings or structural steel base with lipped edges or drain pan and tapped drainage openings.Pump shall be provided with steel shaft coupling guard. Base-mounted pump, coupling guard, and motor shall each be bolted to a fabricated steel base which shall have bolt holes for securing base to supporting surface. Pump shall be accessible for servicing without disturbing piping connections. Shaft seals shall be mechanical-seals.

2.6.2 Mechanical Shaft Seals

Seals shall be single, inside mounted, end-face-elastomer bellows type with stainless steel spring, brass or stainless steel seal head, carbon rotating

face, and tungsten carbide or ceramic sealing face. Glands shall be bronze and of the water-flush design to provide lubrication flush across the face of the seal. Bypass line from pump discharge to flush connection in gland shall be provided, with filter or cyclone particle separator in line.

2.7 EXPANSION TANKS

Tank shall be welded steel, constructed for, and tested to pressure-temperature rating of 125 psi at 150 degrees F. Provide tanks precharged to the minimum operating pressure. Tank shall have a replaceable polypropylene or butyl lined bladder which keeps the air charge separated from the water; shall be the captive air type.

Tanks shall be size to accommodate expanded water of the system generated within the normal operating temperature range, limiting this pressure increase at all components in the system to the maximum allowable pressure at those components. Each tank air chamber shall be fitted with a drain, fill, an air charging valve, and system connections. Tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The only air in the system shall be the permanent sealed-in air cushion contained within the expansion tank.

2.8 AIR SEPARATOR TANKS

External air separation tank shall have an internal design constructed of stainless steel and suitable for creating the required vortex and subsequent air separation. Tank shall be steel, constructed for, and tested to pressure-temperature rating of 125 psi at 150 degrees F.. Tank shall have tangential inlets and outlets connections, threaded for 2 inches and smaller and flanged for sizes 2 1/2 inches and larger. Air released from a tank shall be vented as indicated.

Unit shall have a removable system strainer with blow-down connection.

2.9 ELECTRICAL WORK

Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 16402 INTERIOR DISTRIBUTION SYSTEM. Manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers including the required monitors and timed restart.

Provide high efficiency type, single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11.

Provide polyphase, squirrel-cage medium induction motors, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor

torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

Provide variable frequency drives for motors as specified to have them.

2.10 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

2.10.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided. The factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test.

Salt-spray fog test shall be in accordance with ASTM B 117, and for that test, the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark. The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen.

If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

2.10.2 Shop Painting Systems for Metal Surfaces

Clean, retreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 120 degrees F shall be cleaned to bare metal.

Where hot-dip galvanized steel has been cut, resulting surfaces with no galvanizing shall be coated with a zinc-rich coating conforming to ASTM D 520, Type I.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

b. Temperatures Between 120 and 400 degrees F: Metal surfaces subject to temperatures between120 and 400 degrees F shall receive two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

2.11 FACTORY APPLIED INSULATION

Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes shall be determined by ASTM E 84.

Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

Adhesive shall have a VOC content not to exceed 70 g/l.

2.12 NAMEPLATES

Major equipment including pumps, pump motors, expansion tanks, and air separator tanks shall have the manufacturer's name, type or style, model or serial number on a plate secured to the item of equipment. The nameplate of the distributing agent will not be acceptable. Plates shall be durable and legible throughout equipment life and made of anodized aluminum or stainless steel. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.13 RELATED COMPONENTS/SERVICES

2.13.1 Drain and Make-Up Water Piping

Requirements for drain and make-up water piping and backflow preventer's is specified in Section 15400 PLUMBING, GENERAL PURPOSE.

2.13.2 Cathodic Protection

Use unions or lined nipples rated for cathodic protection when connecting two dissimilar metals.

2.13.3 Field Applied Insulation

Requirements for field applied insulation is specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.13.4 Field Applied Insulation

Requirements for field installed insulation is specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as supplemented and modified by this specification section.

2.13.5 Field Painting

Requirements for painting of surfaces not otherwise specified, and finish painting of items only primed at the factory, are specified in Section 09900 PAINTS AND COATINGS.

2.13.5.1 Color Coding

Requirements for color coding for piping identification are specified in Section 09900 PAINTS AND COATINGS.

PART 3 EXECUTION

3.1 INSTALLATION

Cut pipe accurately to measurements established at the jobsite, and work into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation is not permitted without written approval. Cut pipe or tubing square, remove burrs by reaming, and fashion to permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

Notify the Contracting Officer in writing at least 15 calendar days prior to the date the connections are required. Obtain approval before interrupting service. Furnish materials required to make connections into existing systems and perform excavating, backfilling, compacting, and other incidental labor as required. Furnish labor and tools for making actual connections to existing systems.

3.1.1 Welding

Provide welding work specified this section for piping systems in conformance with ASME B31.9, as modified and supplemented by this specification section and the accompanying drawings. The welding work includes: qualification of welding procedures, welders, welding operators, brazers, brazing operators, and nondestructive examination personnel; maintenance of welding records, and examination methods for welds.

3.1.1.1 Employer's Record Documents (For Welding)

Submit for review and approval the following documentation. This documentation and the subject qualifications shall be in compliance with ASME B31.9.

a. List of qualified welding procedures that is proposed to be used to provide the work specified in this specification section.

b. List of qualified welders, brazers, welding operators, and brazing operators that are proposed to be used to provide the work specified in this specification section.

c. List of qualified weld examination personnel that are proposed to be used to provide the work specified in this specification section.

3.1.1.2 Welding Procedures and Qualifications

a. Specifications and Test Results: Submit copies of the welding

procedures specifications and procedure qualification test results for each type of welding required. Approval of any procedure does not relieve the Contractor of the responsibility for producing acceptable welds. Submit this information on the forms printed in ASME BPVC SEC IX or their equivalent.

b. Certification: Before assigning welders or welding operators to the work, submit a list of qualified welders, together with data and certification that each individual is performance qualified as specified. Do not start welding work prior to submitting welder, and welding operator qualifications. The certification shall state the type of welding and positions for which each is qualified, the code and procedure under which each is qualified, date qualified, and the firm and individual certifying the qualification tests.

3.1.1.3 Examination of Piping Welds

Conduct non-destructive examinations (NDE) on piping welds and brazing and verify the work meets the acceptance criteria specified in ASME B31.9. NDE on piping welds covered by ASME B31.9 is visual inspection only. Submit a piping welds NDE report meeting the requirements specified in ASME B31.9.

3.1.1.4 Welding Safety

Welding and cutting safety requirements shall be in accordance with AWS Z49.1.

3.1.2 Directional Changes

Make changes in direction with fittings, except that bending of pipe 4 inches and smaller is permitted, provided a pipe bender is used and wide weep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees is not permitted. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations is not acceptable.

3.1.3 Functional Requirements

Pitch horizontal supply mains down in the direction of flow as indicated. The grade shall not be less than 1 inch in 40 feet. Reducing fittings shall be used for changes in pipe sizes. Cap or plug open ends of pipelines and equipment during installation to keep dirt or other foreign materials out of the system.

Pipe not otherwise specified shall be uncoated. Connections to appliances shall be made with malleable iron unions for steel pipe 2-1/2 inches or less in diameter, and with flanges for pipe 3 inches and above in diameter. Connections between ferrous and copper piping shall be electrically isolated from each other with dielectric waterways or flanges.

Piping located in air plenums shall conform to NFPA 90A requirements. Pipe and fittings installed in inaccessible conduits or trenches under concrete floor slabs shall be welded. Equipment and piping arrangements shall fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance. Electric isolation fittings shall be provided between dissimilar metals.

3.1.4 Fittings and End Connections

3.1.4.1 Threaded Connections

Threaded connections shall be made with tapered threads and made tight with PTFE tape complying with ASTM D 3308 or equivalent thread-joint compound applied to the male threads only. Not more than three threads shall show after the joint is made.

3.1.4.2 Brazed Connections

Brazing, AWS BRH, except as modified herein. During brazing, the pipe and fittings shall be filled with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, both the outside of the tube and the inside of the fitting shall be cleaned with a wire fitting brush until the entire joint surface is bright and clean. Do not use brazing flux. Surplus brazing material shall be removed at all joints. Steel tubing joints shall be made in accordance with the manufacturer's recommendations. Piping shall be supported prior to brazing and not be sprung or forced.

3.1.4.3 Welded Connections

Branch connections shall be made with welding tees or forged welding branch outlets. Pipe shall be thoroughly cleaned of all scale and foreign matter before the piping is assembled. During welding, the pipe and fittings shall be filled with an inert gas, such as nitrogen, to prevent the formation of scale. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.9. Weld defects shall be removed and rewelded at no additional cost to the Government. Electrodes shall be stored and dried in accordance with AWS D1.1/D1.1M or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.4.4 Flanges and Unions

Except where copper tubing is used, union or flanged joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items. Flanged joints shall be assembled square end tight with matched flanges, gaskets, and bolts. Gaskets shall be suitable for the intended application.

3.1.5 Valves

Isolation ball or butterfly valves shall be installed on each side of each piece of equipment, at the midpoint of all looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purpose. Isolation valves may be omitted where balancing cocks are installed to provide both balancing and isolation functions. Each valve except check valves shall be identified. Valves in horizontal lines shall be installed with stems horizontal or above.

3.1.6 Air Vents

Air vents shall be provided at all high points, on all water coils, and where indicated to ensure adequate venting of the piping system.

3.1.7 Drains

Drains shall be provided at all low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

3.1.8 Flexible Pipe Connectors

Connectors shall be attached to components in strict accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the flexible pipe connector manufacturer and shall be provided at the intervals recommended.

3.1.9 Temperature Gauges

Temperature gauges shall be located on coolant supply and return piping at each heat exchanger, on condenser water piping entering and leaving a condenser, at each automatic temperature control device without an integral thermometer, and where indicated or required for proper operation of equipment. Thermal wells for insertion thermometers and thermostats shall extend beyond thermal insulation surface not less than 1 inch.

3.1.10 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as supplemented and modified in this specification section. Pipe hanger types 5, 12, and 26 shall not be used. Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Piping subjected to vertical movement, when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers.

3.1.10.1 Hangers

Type 3 shall not be used on insulated piping. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

3.1.10.2 Inserts

Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustments may be used if they otherwise meet the requirements for Type 18 inserts.

3.1.10.3 C-Clamps

Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

3.1.10.4 Angle Attachments

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

3.1.10.5 Saddles and Shields

Where Type 39 saddle or Type 40 shield are permitted for a particular pipe

attachment application, the Type 39 saddle, connected to the pipe, shall be used on all pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 40 shields shall be used on all piping less than 4 inches and all piping 4 inches and larger carrying medium less than 60 degrees F. A high density insulation insert of cellular glass shall be used under the Type 40 shield for piping 2 inches and larger.

3.1.10.6 Horizontal Pipe Supports

Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves.

3.1.10.7 Vertical Pipe Supports

Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.

3.1.10.8 Pipe Guides

Type 35 guides using, steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

3.1.10.9 Steel Slides

Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger, a Type 39 saddle shall be used. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

3.1.10.10 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

3.1.10.11 Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads. Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown shall be provided under this section. Material used for support shall be as specified under Section 05120 STRUCTURAL STEEL.

3.1.10.12 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floors or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead

applications shall be constructed of ferrous materials only. Structural steel brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material used for support shall be as specified under Section 05120 STRUCTURAL STEEL.

3.1.11 Pipe Alignment Guides

Pipe alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 5 feet on each side of each expansion joint, and in lines 4 inches or smaller not more than 2 feet on each side of the joint.

3.1.12 Pipe Anchors

Anchors shall be provided where indicated. Unless indicated otherwise, anchors shall comply with the requirements specified.Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required.

Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline. Where pipe and conduit penetrations of vapor barrier sealed surfaces occur, these items shall be anchored immediately adjacent to each penetrated surface, to provide essentially zero movement within penetration seal.

3.1.13 Building Surface Penetrations

Sleeves shall not be installed in structural members except where indicated or approved. Except as indicated otherwise piping sleeves shall comply with requirements specified. Sleeves in nonload bearing surfaces shall be galvanized sheet metal, conforming to ASTM A 653/A 653M, Coating Class G-90, 20 gauge. Sleeves in load bearing surfaces shall be uncoated carbon steel pipe, conforming to ASTM A 53/A 53M. Sealants shall be applied to moisture and oil-free surfaces and elastomers to not less than 1/2 inch depth. Sleeves shall not be installed in structural members.

Sealants used in the building interior shall have a VOC content not more than 250 g/l.

3.1.13.1 General Service Areas

Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall be of such size as to provide a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over-insulation and sleeve shall be sealed in accordance with Section 07920 JOINT SEALANTS.

3.1.13.2 Waterproof Penetrations

Pipes passing through roof or floor waterproofing membrane shall be installed through a .17 ounce copper sleeve, each within an integral skirt

or flange.

Flashing sleeve shall be suitably formed, and skirt or flange shall extend not less than 8 inches from the pipe and be set over the roof or floor membrane in a troweled coating of bituminous cement. The flashing sleeve shall extend up the pipe a minimum of 2 inches above the roof or floor penetration. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Penetrations shall be sealed by the following method.

a. Modular Mechanical Type Sealing Assembly: A modular mechanical type sealing assembly shall be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut.

   After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal rubber sealing elements to expand and provide a watertight seal between the pipe/conduit seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved.

3.1.13.3 Fire-Rated Penetrations

Penetration of fire-rated walls, partitions, and floors shall be sealed as specified in Section 07840 FIRESTOPPING.

3.1.13.4 Escutcheons

Finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms, shall be provided with escutcheons. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheon shall be secured to pipe or pipe covering.

3.1.14 Access Panels

Access panels shall be provided where indicated for all concealed valves, vents, controls, and additionally for items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced.

3.2 ELECTRICAL INSTALLATION

Install electrical equipment in accordance with NFPA 70 and manufacturers instructions.

3.3 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of all foreign matter. A temporary bypass shall be provided for all water coils to prevent flushing water from passing through coils. Strainers and valves

shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from all water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed.

3.4 FIELD TESTS

Field tests shall be conducted in the presence of the Owner's Representative to verify systems compliance with specifications. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor.

3.4.1 Equipment and Component Isolation

Prior to testing, equipment and components that cannot withstand the tests shall be properly isolated.

3.4.2 Pressure Tests

Each piping system shall be hydrostatically tested at a pressure not less than 150 psig for period of time sufficient to inspect every joint in the system and in no case less than 2 hours. Test pressure shall be monitored by a currently calibrated test pressure gauge. Leaks shall be repaired and piping retested until test requirements are met. No leakage or reduction in gage pressure shall be allowed.

Leaks shall be repaired by rewelding or replacing pipe or fittings. Caulking of joints will not be permitted. Concealed and insulated piping shall be tested in place before concealing.

Submit for approval pressure tests reports covering the above specified piping pressure tests; describe the systems tested, test results, defects found and repaired, and signature of the pressure tests' director. Obtain approval from the Owner's Representative before concealing piping or applying insulation to tested and accepted piping.

3.4.3 Related Field Inspections and Testing

3.4.3.1 Piping Welds

Examination of Piping Welds is specified in the paragraph above entitled "Examination of Piping Welds".

3.4.3.2 HVAC TAB

Requirements for testing, adjusting, and balancing (TAB) of HVAC water piping, and associated equipment is specified in Section 15950 HVAC TESTING/ADJUSTING/BALANCING. Coordinate with the TAB team, and provide support personnel and equipment as specified in Section 15950 HVAC TESTING/ADJUSTING/BALANCING to assist TAB team to meet the TAB work requirements.

3.5 INSTRUCTION TO VDOT PERSONNEL

Furnish the services of competent instructors to give full instruction to the designated personnel in the adjustment, operation, and maintenance,

including pertinent safety requirements, of all systems. Instructors shall be thoroughly familiar with all parts of the installation and shall be instructed in operating theory as well as practical operation and maintenance work. Submit a lesson plan for the instruction course for approval. The lesson plan and instruction course shall be based on the approved operation and maintenance data and maintenance manuals.

Conduct a training course for the operating staff and maintenance staff selected by the Owner's Representative. Give the instruction during the first regular work week after the equipment or system has been accepted and turned over for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be two man-day. Use approximately half of the time for classroom instruction and the other time for instruction at the location of equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

-- End of Section --

SECTION 15400

PLUMBING, GENERAL PURPOSE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22	(1999; A 2001) Relief Valves for Hot Water Supply Systems

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2002) Atmospheric Type Vacuum Breakers
ASSE 1003	(2001) Water Pressure Reducing Valves
ASSE 1005	(1999) Water Heater Drain Valves
ASSE 1010	(2004) Water Hammer Arresters
ASSE 1011	(2004) Hose Connection Vacuum Breakers
ASSE 1012	(2002) Backflow Preventer with Intermediate Atmospheric Vent
ASSE 1013	(1999) Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers
ASSE 1018	(2001) Trap Seal Primer Valves - Potable, Water Supplied
ASSE 1019	(2004) Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type
ASSE 1020	(2004) Pressure Vacuum Breaker Assembly

AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA 10079	(1998) Standard Methods for the Examination of Water and Wastewater
AWWA B300	(1999) Hypochlorites
AWWA B301	(2004) Liquid Chlorine
AWWA C203	(2002; A C203a-99) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

AWWA C606	(2004) Grooved and Shouldered Joints
AWWA C651	(1999) Disinfecting Water Mains
AWWA C652	(2002) Disinfection of Water-Storage Facilities
AWWA C700	(2002) Cold-Water Meters - Displacement Type, Bronze Main Case
AWWA C701	(2002) Cold-Water Meters - Turbine Type, for Customer Service

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2004) Filler Metals for Brazing and Braze Welding
AWS B2.2	(1991) Brazing Procedure and Performance Qualification

ASME INTERNATIONAL (ASME)

ASME A112.1.2	(2002; R 2004) Air Gaps in Plumbing Systems
ASME A112.14.1	(2003)Backwater Valves
ASME A112.36.2M	(1991; R 2002) Cleanouts
ASME A112.6.1M	(1997; R 2002) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.6.3	(2001) Floor and French Drains
ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose, Inch
ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose, Inch
ASME B16.12	(1998) Cast Iron Threaded Drainage Fittings
ASME B16.15	(1985; R 2004) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2002) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(2002) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.24	(2002) Cast Copper Alloy Pipe Flanges and

	Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500, and 2500
ASME B16.29	(2002) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.34	(1996) Valves Flanged, Threaded, and Welding End
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions
ASME B16.4	(1998) Gray Iron Threaded Fittings
ASME B16.5	(2003) Pipe Flanges and Flanged Fittings
ASME B31.5	(2001) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2000) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)

ASTM A 105/A 105M	(2003) Carbon Steel Forgings for Piping Applications
ASTM A 183	(2003) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(2004c) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 515/A 515M	(2003) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516/A 516M	(2004) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 518/A 518M	(1999; R 2003) Corrosion-Resistant High-Silicon Iron Castings
ASTM A 53/A 53M	(2004a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 2004) Ductile Iron Castings
ASTM A 733	(2003) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 74	(2004a) Cast Iron Soil Pipe and Fittings
ASTM A 888	(2004a) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain,

	Waste, and Vent Piping Applications
ASTM B 152/B 152M	(2000) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 306	(2002) Copper Drainage Tube (DWV)
ASTM B 32	(2004) Solder Metal
ASTM B 370	(2003) Copper Sheet and Strip for Building Construction
ASTM B 42	(1998) Seamless Copper Pipe, Standard Sizes
ASTM B 43	(1998) Seamless Red Brass Pipe, Standard Sizes
ASTM B 584	(2004) Copper Alloy Sand Castings for General Applications
ASTM B 75	(2002) Seamless Copper Tube
ASTM B 813	(2000e1) Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B 828	(2002) Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM B 88	(1999e1) Seamless Copper Water Tube
ASTM B 88M	(2003) Seamless Copper Water Tube (Metric)
ASTM C 1053	(2000) Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications
ASTM C 564	(2003a) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM D 1785	(2004a) Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2000	(2003ae1) Rubber Products in Automotive Applications
ASTM D 2235	(20041) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2239	(2003) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D 2241	(2004b) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

ASTM D 2447	(2003) Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
ASTM D 2464	(1999e1) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(2002) Poly(Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(2004e1) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(2004) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2661	(2002) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2665	(2004a) Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2672	(1996a; R 2003) Joints for IPS PVC Pipe Using Solvent Cement
ASTM D 2683	(2004) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D 2737	(2003) Polyethylene (PE) Plastic Tubing
ASTM D 2822	(1991; R 1997e1) Asphalt Roof Cement
ASTM D 2846/D 2846M	(1999e1) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
ASTM D 2855	(1996; R 2002) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2996	(2001) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 3035	(2003a) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D 3122	(1995; R 2002) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings
ASTM D 3138	(2004) Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components

ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1996a; R 2003) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3261	(2003) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3308	(2001) PTFE Resin Skived Tape
ASTM D 3311	(2002e1) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM D 4101	(2004a) Polypropylene Injection and Extrusion Materials
ASTM E 1	(2003a) ASTM Thermometers
ASTM F 1760	(2001) Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content
ASTM F 437	(1999) Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 438	(2004) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F 439	(2002e1) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 441/F 441M	(1999e1) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F 442/F 442M	(1999) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM F 477	(2002e1) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 493	(2004) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
ASTM F 628	(2001) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core
ASTM F 877	(2002a) Crosslinked Polyethylene (PEX) Plastic Hot- and Cold- Water Distribution Systems
ASTM F 891	(2004) Coextruded Poly (Vinyl Chloride)

(PVC) Plastic Pipe with a Cellular Core

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(2004) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(2004) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015	(1994; R 1995) Copper Tube Handbook

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR Manual	(9th Edition) Manual of Cross-Connection Control

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1	(1998) Accessible and Usable Buildings and Facilities
ICC IPC	(2003)International Plumbing Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-44	(1996; R 2001) Steel Pipeline Flanges
MSS SP-58	(2002) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-67	(2002) Butterfly Valves
MSS SP-69	(2002) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service

MSS SP-73	(2003) Brazing Joints for Copper and Copper Alloy Pressure Fittings
MSS SP-78	(1998) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	(2001) Class 3000 Steel Pipe Unions, Socket-Welding and Threaded
MSS SP-85	(2002) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2002) Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF 14	(2003) Plastics Piping System Components and Related Materials
NSF 61	(2003e) Drinking Water System Components - Health Effects

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA-01	(1998) Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201	(1992) Water Hammer Arresters

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508	(1997) Hose Clamp Specifications

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

PL 93-523	(1974; A 1999) Safe Drinking Water Act

UNDERWRITERS LABORATORIES (UL)

UL 499	(1997; R 2002) Electric Heating Appliances

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

SD-03 Product Data

Flush valve water closets

Flush valve urinals

Wall hung lavatories

Service sinks

Drinking-water coolers

Water heaters

Pumps

Backflow prevention assemblies

Vibration-Absorbing Features

Solvent Cements and Adhesives

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

Provide flush rate and flow rates, as applicable, for all plumbing fixtures.

Submit MSDS highlighting VOC content for each filed-applied solvent cement and adhesive used in the building interior.

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Test of Backflow Prevention Assemblies.

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment

Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

SD-10 Operation and Maintenance Data

Plumbing System

Submit in accordance with Section 01781, "Operation and Maintenance Data."

1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Architect/Engineer firm.

1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall."

1.3.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative

requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Architect/Engineer firm as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Architect/Engineer firm. Replace damaged or defective items.

1.5 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC.

1.6 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Architect/Engineer of any discrepancy before performing any work.

1.7 INSTRUCTION TO VDOT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated VDOT personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the VDOT for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.8 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. Pipe schedules shall be selected based on service requirements. Pipe

fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A 74, AWWA C606. For hubless type: CISPI 310

b. Coupling for Steel Pipe: AWWA C606.

c. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

d. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.

e. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.

f. Solder Material: Solder metal shall conform to ASTM B 32.

g. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.

h. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe, ASTM D 3308.

i. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C 564.

j. Rubber Gaskets for Grooved Pipe: ASTM D 2000, maximum temperature

230 degrees F.

k. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.

l. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A 183.

m. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D 3138. Solvent cement shall have a VOC content not to exceed 325 g/l.

n. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D 2235. Solvent cement shall have a VOC content not to exceed 325 g/l.

o. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D 2564 and ASTM D 2855. Solvent cement shall have a VOC content not to exceed 510 g/l.

p. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F 493. Solvent cement shall have a VOC content not to exceed 490 g/l.

q. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105/A 105M. Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193/A 193M.

r. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D 3122. Plastic solvent cement shall have a VOC content not to exceed 250 g/l.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201.

b. Copper, Sheet and Strip for Building Construction: ASTM B 370.

c. Asphalt Roof Cement: ASTM D 2822.

d. Hose Clamps: SAE J1508.

e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

f. Metallic Cleanouts: ASME A112.36.2M.

g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines:

AWWA C203.

i. Hypochlorites: AWWA B300.

j. Liquid Chlorine: AWWA B301.

k. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.

l. Thermometers: ASTM E 1. Mercury shall not be used in thermometers.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 15080 MECHANICAL INSULATION.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	ANSI Z21.22
Water Pressure Reducing Valves	ASSE 1003

Description	Standard
Water Heater Drain Valves	ASSE 1005
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22

2.3.1 Backwater Valves

Backwater valves shall be either separate from the floor drain or a combination floor drain, P-trap, and backwater valve, as shown. Valves shall have cast-iron bodies with cleanouts large enough to permit removal of interior parts. Valves shall be of the flap type, hinged or pivoted, with revolving disks. Hinge pivots, disks, and seats shall be nonferrous metal. Disks shall be slightly open in a no-flow no-backwater condition. Cleanouts shall extend to finished floor and be fitted with threaded countersunk plugs.

2.3.2 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

2.3.3 Wall Hydrants (Frostproof)

ASSE 1019 with vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

2.3.4 Thermostatic Mixing Valves

Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 5 degrees F of any setting.

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with ICC IPC. Fixtures for use by the physically handicapped shall be in accordance with ICC A117.1. Vitreous china, nonabsorbent, hard-burned, and vitrified

throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature. Fixtures shall be provided as specified on sheet P4, "Plumbing Fixtures Schedule", with (2) two alternative manufacturers listed therein.

2.5 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR Manual. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.6 DRAINS

2.6.1 Floor Drains

Floor drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor drains shall conform to ASME A112.6.3.

2.7 TRAPS

Unless otherwise specified, traps shall be copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be with a cleanout.

Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.8 WATER HEATERS

Water heater types and capacities shall be as indicated.

2.8.1 Electric Instantaneous Water Heaters (Tankless)

UL 499 and UL listed flow switch activated, tankless electric instantaneous water heater for wall mounting below sink or lavatory.

2.9 DOMESTIC WATER SERVICE METER

Cold water meters 2 inches and smaller shall be positive displacement type conforming to AWWA C700. Cold water meters 2-1/2 inches and larger shall be turbine type conforming to AWWA C701. Meter register may be round or straight reading type, as provided by the local utility. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

2.10 MISCELLANEOUS PIPING ITEMS

2.10.1 Escutcheon Plates

Provide one piece metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated on copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.10.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors. Provide one inch minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. In fire walls and fire floors, seal both ends of sleeves or core-drilled holes with UL listed fill, void, or cavity material.

2.10.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in the core-drilled hole are completely grouted smooth.

2.10.3 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.10.4 Pipe Hangers (Supports)

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joists with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel and wood with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.10.5 Nameplates

Provide 0.125 inch thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 0.25 inch high normal block lettering into the white core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Plastic pipe shall not be installed in air plenums. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A gate valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the average local frost depth or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping

at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Arechitect/Engineer.

3.1.1.7 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

3.1.2 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.2.2 Mechanical Couplings

Grooved mechanical joints shall be prepared according to the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or narrow-land micrometer. Groove width and dimension of groove from end of the pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

3.1.2.3 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

3.1.2.4 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.2.5 Copper Tube and Pipe

a. Brazed. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA A4015 with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015. Soldered joints shall not be used in compressed air piping between the air comppressor and the receiver.

c. Copper Tube Extracted Joint. Mechanically extracted joints shall be made in accordance with ICC IPC.

3.1.2.6 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe shall have joints made with solvent cement. PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

3.1.3 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.3.1 Sleeve Requirements

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not required for supply, drainage, waste and vent pipe passing through concrete slab on grade, except where penetrating a membrane waterproof floor. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly

positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 4 inches above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation as specified in Section 07920 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated. Sleeves through below-grade walls in contact with earth shall be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls shall conform to the requirements in Section 07840 FIRESTOPPING.

3.1.3.2 Flashing Requirements

Pipes passing through roof shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.3.3 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, water, insects, and vermin. Sealant

shall have a VOC content not to exceed 250 g/l.

3.1.4 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07840 FIRESTOPPING.

3.1.5 Supports

3.1.5.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.5.2 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

a. Types 5, 12, and 26 shall not be used.

b. Type 3 shall not be used on insulated pipe.

c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.

d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

g. Type 39 saddles shall be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.

h. Type 40 shields shall:

(1) Be used on insulated pipe less than 4 inches.

(2) Be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or less.

(3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 8 pcf or greater.

i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 15 feet nor more than 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.

k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:

(1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.

(2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

(3) On pipe 4 inches and larger carrying medium less that 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.

l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

m. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

n. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.5.3 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports

shall not be attached to metal decking.

3.1.6 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface.

3.2 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.2.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.2.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 39 inches above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 30 inches above the floor and arranged to avoid interference with grab bars.

3.2.3 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.2.3.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.2.3.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

3.2.3.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.2.3.4 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

3.2.4 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with ICC IPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the

level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.2.5 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced.

3.2.6 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 2 inches above the flood rim of the funnel to provide an acceptable air gap.

3.2.7 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D 3311. Traps for acid-resisting waste shall be of the same material as the pipe.

3.3 IDENTIFICATION SYSTEMS

3.3.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.4 TESTS, FLUSHING AND DISINFECTION

3.4.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, the Contractor must submit a testing procedure to the Architest/Engineer for approval.

a. Drainage and Vent Systems Test. The final test shall include a smoke test.

b. Building Sewers Tests.

c. Water Supply Systems Tests.

3.4.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.4.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.4.3 System Flushing

3.4.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Architect/Engineer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration. All faucets and drinking water fountains, to include any device considered as an end point device by NSF 61, Section 9, shall be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.

3.4.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish,

furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation.

3.4.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, hydrant, and faucet.

g. Operation of each floor drain by flooding with water.

h. Operation of each vacuum breaker and backflow preventer.

3.4.5 Disinfection

After operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. System shall be flushed as specified, before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Except as herein specified, water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump, shall be used. If after the 24 hour and 6 hour holding periods, the residual solution contains less than 25 ppm and 50 ppm chlorine respectively, flush the piping and tank with potable water, and repeat the above procedures until the required residual chlorine levels are satisfied. The system including the tanks shall then be flushed with clean water until the residual chlorine level is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. Samples of water in disinfected containers shall be obtained from several locations selected by the Architect/Engineer firm. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10079. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. Disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.5 TABLES

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE A	B	C	D	E	F
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets. Pipe and fittings shall be marked with the CISPI trademark.	X	X	X	X	X	
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A 888. Pipe and fittings shall be marked with the CISPI trademark.		X	X	X	X	
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10	X		X	X		
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10				X	X	
5	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47/A 47M for use with Item 5	X	X		X	X	
6	Bronze sand casting grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 5	X	X		X	X	
7	Wrought copper grooved joint pressure pressure fittings for non-ferrous pipe ASTM B 75 C12200, ASTM B 152/B 152M, C11000, ASME B16.22 ASME B16.22 for use with Item 5	X	X				
8	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10				X	X	
9	Steel pipe, seamless galvanized, ASTM A 53/A 53M, Type S, Grade B	X			X	X	
10	Seamless red brass pipe, ASTM B 43		X	X			
11	Bronzed flanged fittings, ASME B16.24 for use with Items 11 and 14				X	X	

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE					
		A	B	C	D	E	F
12	Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14				X	X	
13	Seamless copper pipe, ASTM B 42				X		
14	Cast bronze threaded fittings, ASME B16.15				X	X	
15	Copper drainage tube, (DWV), ASTM B 306	X*	X	X*	X	X	
16	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X	
17	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X	X	
18	Acrylonitrile-Butadiene-Styrene (ABS) plastic drain, waste, and vent pipe and fittings ASTM D 2661, ASTM F 628	X	X	X	X	X	X
19	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D 2665, ASTM F 891, (Sch 40) ASTM F 1760	X	X	X	X	X	X
20	Process glass pipe and fittings, ASTM C 1053						X
21	High-silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint), ASTM A 518/A 518M		X			X	X
22	Polypropylene (PP) waste pipe and fittings, ASTM D 4101						X
23	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996						X

SERVICE:

A - Underground Building Soil, Waste and Storm Drain
B - Aboveground Soil, Waste, Drain In Buildings
C - Underground Vent

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE					
Item #	Pipe and Fitting Materials	A	B	C	D	E	F

D - Aboveground Vent
E - Interior Rainwater Conductors Aboveground
F - Corrosive Waste And Vent Above And Belowground
* - Hard Temper

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE			
Item No.	Pipe and Fitting Materials	A	B	C	D
1	Malleable-iron threaded fittings, a. Galvanized, ASME B16.3 for use with Item 4a	X	X	X	X
	b. Same as "a" but not galvanized for use with Item 4b			X	
2	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47/A 47M, for use with Item 2	X	X	X	
3	Steel pipe: a. Seamless, galvanized, ASTM A 53/A 53M, Type S, Grade B	X	X	X	X
	b. Seamless, black, ASTM A 53/A 53M, Type S, Grade B			X	
4	Seamless red brass pipe, ASTM B 43	X	X		X
5	Bronze flanged fittings, ASME B16.24 for use with Items 5 and 7	X	X		X
6	Seamless copper pipe, ASTM B 42	X	X		X
7	Seamless copper water tube, ASTM B 88, ASTM B 88M	X**	X**	X**	X***
8	Cast bronze threaded fittings, ASME B16.15 for use with Items 5 and 7	X	X		X

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE A	B	C	D
9	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 5, 7 and 8	X	X	X	X
10	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Item 8	X	X	X	X
11	Bronze and sand castings grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 2	X	X	X	
12	Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on outside diameter ASTM D 2447	X			X
13	Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, ASTM D 3035	X			X
14	Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled inside diameter, ASTM D 2239	X			X
15	Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D 3261 for use with Items 14, 15, and 16	X			X
16	Socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe, ASTM D 2683 for use with Item 15	X			X
17	Polyethylene (PE) plastic tubing, ASTM D 2737	X			X
18	Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D 2846/D 2846M	X	X		X
19	Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40	X	X		X

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE A	B	C	D
	and 80, ASTM F 441/F 441M				
20	Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F 442/F 442M	X	X		X
21	Threaded chlorinated polyvinyl chloride (chloride CPVC) plastic pipe fittings, Schedule 80, ASTM F 437, for use with Items 20, and 21	X	X		X
22	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F 438 for use with Items 20, 21, and 22	X	X		X
23	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, ASTM F 439 for use with Items 20, 21, and 22	X	X		X
24	Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D 1785	X			X
25	Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), ASTM D 2241	X			X
26	Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D 2466	X			X
27	Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2467 for use with Items 26 and 27	X			X
28	Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2464	X			X
29	Joints for IPS pvs pipe using solvent cement, ASTM D 2672	X			X
30	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996	X	X		
31	Steel pipeline flanges,	X	X		

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE A	B	C	D
	MSS SP-44				
32	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B 828	X	X		
33	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83	X	X	X	
34	Malleable-iron threaded pipe unions ASME B16.39	X	X		
35	Nipples, pipe threaded ASTM A 733	X	X	X	
36	Crosslinked Polyethylene (PEX) Plastic Pipe ASTM F 877.	X			X

A - Cold Water Service Aboveground
B - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground
C - Compressed Air Lubricated
D - Cold Water Service Belowground
Indicated types are minimum wall thicknesses.
** - Type L - Hard
*** - Type K - Hard temper with brazed joints only or type K-soft temper without joint
**** - In or under slab floors only brazed joints

-- End of Section --

SECTION 15410

PLUMBING FIXTURES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC	(2003) International Plumbing Code

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS WW-P-401	(Rev E; Am 1) Pipe and Pipe Fittings, Cast-Iron, Soil

1.2 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items including all spare parts.

Plumbing Fixtures and Trim
Sanitary Drain, Waste, and Vent Fixtures

Provide flush rate and flow rates, as applicable, for all plumbing fixtures.

SD-07 Certificates

Listing of Product Installation shall be submitted in accordance with paragraph entitled, "Installation," of this section.

Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Plumbing Fixtures and Trim
Sanitary Drain, Waste, and Vent Fixtures

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with paragraph entitled, "Operation and Maintenance," of this section.

1.3 GENERAL REQUIREMENTS

Section 15003 GENERAL MECHANICAL PROVISIONS applies to this section.

Detail Drawings shall be submitted for plumbing fixtures consisting of fabrication and assembly drawings for all parts of the work in sufficient detail to enable the Architect/Engineer firm to check conformity with the requirements of the contract documents.

PART 2 PRODUCTS

2.1 GENERAL

Fixtures shall be of the types defined herein and of the size and capacities indicated.

Manufacturer's Standard Color Charts shall be submitted for plumbing fixtures showing the manufacturer's recommended color and finish selections.

2.2 PLUMBING FIXTURES AND TRIM

Fixtures shall be furnished with the accessories for a complete installation, such as supply fittings, angle valves, escutcheons, couplings, nuts, drain fittings, and pop-up waste fittings, even if the accessories are not specifically called out herein. Rubber compression type connections are not acceptable and brass ferrule type fittings are required.

Vitreous-china and enameled cast-iron plumbing fixtures shall be the product of the same manufacturer, and unless otherwise specified, shall be white. Manufacturer shall be a company of established reputation in the manufacture of plumbing fixtures and one that assembles the plumbing outfits and assumes responsibility for all products supplied.

Exposed traps and double-cone supply tubes for fixtures and equipment shall be connected to rough-piping at the wall, unless otherwise specified. Floor and wall plates shall be as specified herein or as covered by the outfit numbers. Exposed-to-view fixture trimmings, fittings, and fasteners shall be chromium-plated or nickel-plated brass with polished, bright surfaces.

Exposed-to-view fixture supports shall be enameled iron to match the fixture.

Supplies and wastes for lavatories shall be to wall. Sleeves are not required at penetrations.

Each lavatory shall be fitted with a plunger-operated liquid-soap dispenser.

2.2.1 Fixture Supports

Wall-hung fixtures shall be supported by ferrous-metal carriers. Where specified, carriers shall be combination type with adjustable fittings. Water closets and urinals shall have supporting feet not less than 10 inches long, unless construction requires shorter feet or bases.

Lavatories shall be supported from the wall by wall carriers with concealed arms.

2.3 SANITARY DRAIN, WASTE, AND VENT FIXTURES

Sanitary drain, waste, and vent fixtures shall be Type GCS-DWV, of

galvanized carbon steel.

2.3.1 Floor Drains

Floor drains shall be complete with traps.

Floor drains located in slabs on earth shall have hub outlets; those in slabs not on earth shall have threaded outlets or hub outlets, as required to match piping used.

Ferrous floor drain surfaces, except the top of grates, shall be given a heavy coating of coal-tar enamel. Coating shall be applied either at the factory or in the field before installation and before rusting has occurred.

2.3.2 Cleanouts

Cleanouts shall be gastight and watertight and sized to provide quick and easy access for plug removal and rodding tools. Cleanouts shall be aesthetically located with respect to tile patterns, masonry bond, and alignment.

No cleanout plug shall terminate in or above a finished floor or wall surface, except in stack bases and where indicated.

Cleanouts shall have cast-brass raised-head plugs. Not less than two tools for each size and type plug shall be delivered to the Architect/Engineer firm.

Cleanouts set outside of the building and cleanouts in building floors shall have adjustable housings.

Cast-iron bodies shall be coated with manufacturer's standard material.

2.3.3 P-Traps

P-traps shall be extra-heavy cast iron conforming to FS WW-P-401.

PART 3 EXECUTION

3.1 INSTALLATION

Listing of Product Installation shall be submitted for plumbing fixtures identifying at least five units, similar to those proposed for use, that have been in successful service for a minimum of five years. The list shall include purchaser, address of installation, service organization, and date of installation.

Materials, equipment, and fixtures shall be installed as indicated and specified and in accordance with the manufacturer's recommendations.

Installation of plumbing fixtures shall conform to the published or written instructions of the manufacturer for the specific project application, except as otherwise specified herein.

Fixtures shall be clean and free of deleterious material before being installed. Before connecting to water, waste, vent or trap service, the fixture lines shall be blown out with compressed air. During the progress of construction, open ends of fixtures shall be protected at all times to prevent the admission of foreign matter.

3.2 TESTS

The floor drain body and its standard specification strainer shall be tested in compression, while loaded with a 120,000-pound capacity hydraulic machine, by means of a 2-1/2-inch square, 1-inch thick platen placed at the geometric center of the strainer. Deflection measurements from the bottom of the platen shall be taken using a deflection gage graduated in 0.001-inch increments. Cast-iron strainers shall be loaded as rapidly as possible; load-to-failure shall be applied within 2 to 2.5 seconds, and maximum deflection at failure by cracking shall be noted. Ductile-iron and nonferrous strainer permanent deformation shall constitute failure. These strainers shall be loaded to a deflection of 1/16 inch without permanent deformation and to a deflection of 1/8 inchat which or before which, permanent deformation will occur.

Leak tests shall be conducted in accordance with ICC IPC, except as otherwise provided herein. Tests shall be hydrostatic, unless otherwise specified. Only potable water shall be used for testing. The Contractor shall be responsible for approved disposal of contaminated water.

Duration of the test will be determined by the Architect/Engineer firm, who may also terminate the test at any point after it has been determined that fixtures are watertight.

Record of testing shall be maintained by the Contractor and shall be submitted to the Architect/Engineer firm upon acceptance of the equipment by the Owner's Representative.

3.3 OPERATION AND MAINTENANCE

Contractor shall submit 6 copies of the Operation and Maintenance Manuals 30 calendar days prior to testing of plumbing fixtures. Data shall be updated and resubmitted for final approval by the Architect/Engineer firm no later than 30 calendar days prior to contract completion.

-- End of Section --

SECTION 15520

EXTERIOR GROUND LOOP HEAT EXCHANGERS

PART 1 GENERAL

1.1 DESCRIPTION

This section shall include providing exterior underground heat pump heat exchangers. The extent of ground heat exchanger work is indicated on the drawings and schedules, and by the requirements of this section. The buried heat exchangers consist of polyethylene heat fusion-joined piping formed into vertical loops. The loops are connected with prefabricated headers and prefabricated vertical heat exchanger U-bend assemblies.

1.2 RELATED WORK SPECIFIED ELSEWHERE

Refer to Division 1 for additional requirements applicable to the work. Also refer to sub-sections listed below.

A. Section 02315 - Excavation, Filling, and Backfilling

B. Section 15050 - Basic Mechanical materials and Methods.

C. Section 15072 - Vibration Isolation for Air Conditioning Equipment.

D. Section 15521 - Geothermal Heat Pump and Loop Piping Systems (High Density Polyethylene)

E. Section 15522 - Thermal-Enhanced Bentonite Grout.

F. Section 15740 - Ground Source Heat Pumps.

G. Section 15950 - HVAC Testing/Adjusting/Balancing.

1.3 WARRANTIES

Provide manufacturer's standard material warranty for HDPE piping loop. Provide installer's 1-year warranty on the piping installation.

1.4 SUBMITTALS

For Approval:

1. Shop Drawings and Product Data - Submit shop drawings and manufacturers' technical product data for all utility systems specified including all piping and appurtenances.

2. Include submittal for grout material and mix design.

3. Accurately record, on site plan, dimensioned "as built" drawing showing depth and location of horizontal piping and location of each bore hole, measured from permanent fixture such as corner of building, fire hydrant, etc.

4. Certificates and Test Reports - Provide manufacturers'

certificates of compliance (COC) and/or testing reports for pipes, tubing, U-bend heat exchangers, and appurtenances. Submit for review and approval prior to commencement of any pipe or loop installation.

5. Provide Installing Contractor's and Thermal Fusion Technician's records of qualification and related job experience.

6. Submit manufacturer's technical data on fusion machine to be used in fabricating the ground heat exchanger.

7. Loop pressure test procedures and results. Procedures shall be approved prior to commencement of pressure test activities. Provide a 2 working day notification to the Owner's Representative prior to conducting pressure tests.

1.5 QUALITY ASSURANCE

A. Installing Contractor and on site installer shall have a minimum of five (5) years experience in designing, installing, and commissioning vertical ground heat exchangers for ground coupled heat pumps. Five references and contacts for previous jobs of a size and scope comparable to the project under consideration shall be provided.

B. The Drilling Contractor shall be a State licensed well driller. As a minimum, state regulations and guidelines of the National Ground Water Association shall be followed for the backfilling vertical bore holes. Backfill shall be evenly distributed throughout the entire bore to provide maximum heat transfer without voids.

C. Thermal Fusion Technician shall be certified by recognized certification agency and shall have field experience in forming thermally fused joints. Must have completed a polyethylene heat fusion school in which each participant has performed a heat fusion procedure under direct supervision of an IGSHPA-accredited heat fusion technician, as part of an IGSHPA-approved manufacturing certification program, or under direct supervision of a DOT-certified heat fusion technician. Certified technicians must attend a retraining school annually.

D. Manufacturer's Qualifications: Must be regularly engaged in the manufacture of GHP ground heat exchanger materials or fusion equipment for not less than five (5) years.

1.6 REFERENCE STANDARDS

A. ASHRAE 1995 Commercial/Institutional Ground Source Heat Pump Engineering Manual (ISBN 1-883413-21-4)

B. ASHRAE 1997 Ground Source Heat Pumps: Design of Geothermal Systems for Commercial and Institutional Buildings. (S.P. Kavanaugh and K. Rafferty) (ISBN 1-883413-52-4)

C. County Soil Conservation Service Soil Survey.

D. State Drilling Logs for local area.

E. IGSHPA 1997 Closed Loop/Geothermal Heat Pump Systems Design and Installation Standards

F. IGSHPA 1988 Closed Loop/Ground-Source Heat Pump Systems Installation

Guide

G. IGSHPA 1989 Soil and Rock Classification for the Design of Ground-Coupled Heat Pump Systems - Field Manual

H. IGSHPA 1991Grouting Procedures for Geothermal Heat Pump Systems

I. IGSHPA 1994 Closed-Loop Geothermal Systems: Slinky Installation Guide

J. IGSHPA 1997 Geothermal Heat Pump System Design Training for Architects and Engineers - Appendices and Manual

K. EPRI 1994 Water-Loop Heat Pump Systems Vol. 1, Rev. 1

L. Cost Containment for GSHP Systems by Steve Kavanaugh & Christopher Gilbert

M. Grout Thermal Conductivity and Vertical Loop Design by C. P. Remund

N. National Ground Water Association's Guidelines for the Construction of Vertical Boreholes for Closed Loop Heat Pump Systems.

PART 2 PRODUCTS

2.1 MATERIALS AND MIXES

A. Grout: High solids bentonite grout, bags labeled "Grout" ('GEL" label is not acceptable). Paddle mix grout with minimum shearing action and agitation of the slurry. See section 15522.

B. Concrete: All concrete shall have 3000 psi 28 days compressive strength, air entrained and shall conform to ASTM C94 for ready mixed concrete.

2.2 FABRICATION AND MANUFACTURE

A. Heat Pump Water Piping and Fittings:

1. Materials: Virgin prime and comply with IGSHPA Standard I.C.3 for polyethylene with a minimum cell classification of PE345434C per ASTM D3350. See Section 15110.

B. Fittings shall be compatible with the pipe material or from the same material as the pipes.

C. Joints:

1. Thermally fused joined per IGSHPA Standards. No socket fusion (except electro-fusion) on pipe larger than 2" will be excepted.

2. No joints in vertical tubing; maximum two joints at return U-bend. The return U-bend be factory equipped with anti-buoyancy port.

D. Miscellaneous:

1. Markings: Pipe shall be marked with manufacturer's name and product name, nominal size, ASTM dimensional standard, PPI material classification, cell classification, sequential footage, and

manufacturer's date code. Print line shall repeat every two feet.

PART 3 EXECUTION

3.1 GENERAL

A. Protection of Existing Utilities Structures. Protect the existing utilities shown on the drawings or the locations of which are known prior to excavation, from damage during excavation and backfilling of trenches and, if damaged, repair them at no expense to the Owner.

B. Make repairs under the supervision of the utility concerned.

C. Provide a thermal conductivity test for actual soil performance data. The thermal conductivity test should be the first thing done.

D. Ground field layout shall be capable of being purged of air and debris, balanced within 15 percent without flow regulators, and connected in a minimum number of trenches and/or pits.

E. Fill U-bend loops with water and insert the U-bend into the bore to the depth stated in the design documents.

F. Examine areas and conditions under which ground heat exchanger systems are to be installed. Verify that the loop layout is appropriate for site conditions. After approval from Owner's Representative, correct site problems before proceeding.

3.2 PREPARATION EXCAVATION

A. General: Perform all excavation of every description and of whatever substances encountered, to the depths required or indicated on the drawings, in accordance with OSHA.

1. During excavation, deposit material suitable for backfill in an orderly manner a sufficient distance from the excavation banks to avoid overloading and to prevent slides or caveins. Dispose of material unsuitable for backfill as directed by the Owner's Representative.

2. Grade as necessary to prevent surface water from flowing into trenches or other excavations, and remove any water accumulating therein by pumping or by other acceptable method.

3. Unless otherwise specified, all excavation shall be by open cut. Fill any excess excavation below the levels indicated for structures or pipe with sand, gravel or concrete, as directed by the Owner's Representative.

B. Trench Excavation: Excavate true to line to an elevation at least 2 feet above the top of pipe to provide a clear space on either side of the pipe to facilitate bedding. See Section 02315 for details.

1. Heat pump water piping shall be provided with a minimum cover of five (5) feet.

2. Replace any material excavated beneath pipe entering and leaving manholes with sand or gravel fill and extend such fill to the center of pipe for a distance of at least 3 feet from face of manhole and

terminate at a joint.

3. Backfill the trench with selected bedding material and compact to provide uniform and continuous bearing for the pipe. Dispose of the unsuitable material as directed by the Owner's Representative.

4. Provide tracer wire in trench with non-metallic piping as indicated in Section 02531.

C. Borrow: When borrow areas are not indicated on the plans, it is the Contractor's responsibility to locate and obtain borrow material, subject to the acceptance by the Owner's Representative.

D. Shoring Requirements: Perform all shoring and sheeting that is required to protect the excavation and to safeguard employees in accordance with OSHA. Widen excavation to provide for space occupied by shoring and sheeting.

E. Shoring shall meet the requirements of all applicable codes and regulations.

F. Cold Weather Protection. Protect excavation bottoms against freezing when atmospheric temperature is less than 35oF.

G. Dewatering: Do not allow water to accumulate in excavations. Prevent surface water and subsurface or ground water from flowing into excavation. See Section 02315 for details.

H. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

I. Do not use trench excavations as temporary drainage ditches. See Section 02315 for details on diverting ditches.

3.3 INSTALLATION

A. Excavation and vertical drilling work shall be performed by qualified Contractors as defined in 1.05 above.

B. Pipe shall be installed in accordance with recommendations of ASHRAE and IGSHPA. Pipe joints shall be heat fusion type and shall be made as recommended by the pipe manufacturer.

C. Open ends of all pipe shall be sealed to prevent entry of contaminants until final connections are made.

D. Vertical loop piping shall be filled with water and pressure tested prior to insertion into the bore hole and tested again after manifolding.

E. After connection to the vertical loop piping and prior to backfilling, each lateral shall be filled with water and pressure tested.

F. Results of all tests shall be recorded and supplied to the Owner's Representative upon completion of the project.

G. All final tests shall be witnessed by and the report signed by the Owner's Representative. Provide minimum of 2 working days advance notice to

the Owner's Representative prior to testing.

H. Grouting: Vertical bore holes shall, as a minimum, be grouted in adherence with all state and local requirements and with the guidelines of NGWA. Since settling of the grouting material may occur after the initial grouting, Contractor shall monitor each bore hole and continue adding grout as required. Refer to Section 15522.

I. Use temporary casings to support unstable soils.

3.4 BACKFILL

A. General: Do not backfill trenches until all required inspections are made and tests are performed.

B. Backfill horizontal trenches with the excavated materials specified for back filling and in accordance with Section 02315. Broken concrete shall not be used as backfill material.

C. No backfilling shall take place in freezing weather, and no backfill shall be made with frozen material. If unfrozen fill is available, it may be used a backfill material.

D. Adjust the moisture content of the backfill material if required for proper compaction.

E. Reopen any trenches improperly backfilled, or where settlement occurs, to the depth required for proper compaction, refill and compact to specified density.

F. Compact all backfill for structures to the specified density.

G. Around Horizontal Pipe: Deposit backfill around the pipe in 6 inch layers and thoroughly compact. Refer to Section 02315. Be careful not to disturb the pipe. Perform back filling simultaneously on both sides of the pipe.

H. Remainder of Trench: Deposit suitable backfill material in layers not exceeding 6 inches in loose depth and thoroughly compact each layer.

I. Bedding: Crushed rock, sand, or gravel bedding, as defined in section 02200, shall be used where selected bedding material is required by the drawings, specifications or Engineer during construction to replace unsuitable foundation material.

J. Warning tape shall be of the type specifically manufactured for marking and locating underground utilities. The tape shall be installed directly above the pipe, at a depth of 18 inches below finished grade unless otherwise shown. The tape shall be acid and alkali resistant polyethylene film, 6 inches wide with minimum thickness of 0.004 inch and shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise with an elongation factor of 350 percent. Tape color shall be yellow and shall bear a continuous printed inscription describing the service. Tape shall have integral wires, foil backing, or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep. The metallic core shall be encased in a protective jacket or provided with other means to protect it from corrosion.

3.5 ADJUSTMENTS AND CLEANING

A. Pressure Testing

1. Utilizing the purging unit and the procedures recommended by IGSHPA, conduct a pressure and flow test on the ground heat exchanger to ensure the system is free of blockage. If the flow test indicates blockage, locate the blockage using the manufacturer's recommendation, remove the blockage, then purge and conduct the pressure and flow test again until all portions of the system are free-flowing.

2. The flow test shall be observed and approved by the Owner's Representative. Form 1, "Ground Heat Exchanger Inspection and Test Report," attached, shall be completed for each system by the Owner's Representative before the systems can be backfilled.

B. Flushing and Purging:

1. Configure flushing/purging unit as recommended by IGSHPA.

2. Flush lines and appurtenances as required to remove all dirt and contaminants within the piping system with potable water until no dirty water appears at outlet.

3. Purge air from system, or sections of system, by maintaining minimum of 2 feet per second through all pipe. Purge until no air bubbles are observed leaving the system.

4. Notify Owner's Representative minimum 2 days before flushing operation.

5. Utilize a portable temporary purging unit consisting of the following (see IGSHPA Closed Loop Ground Source Heat Pump Systems Installation Guide, Figures 7.7 & 7.8, pages 152-3):

a) High volume, high head purge pump capable of maintaining the required purge velocity in all sections of the pipe.

b) Open reservoir with inlet and outlet valves and pressure gauge

c) Filter assembly with bypass

d) Flow meter

e) Pressure gauge

f) Connecting piping

g) Connecting hoses

6. Using a purge pump and the procedures recommended by IGSHPA, flush and purge each ground heat exchanger system at 2 fps flow velocity until free of air, dirt, and debris. Perform the flushing and purging operation with the water source heat pumps isolated by shut-off valves from the ground heat exchanger system.

7. After the ground heat exchanger is completely flushed of air and debris, open the isolation valves and permit circulation through the heat pumps until the entire system is flushed and purged. Allow pump to

run 15 minutes after the last air bubbles have been removed.

3.6 REPORTS

A. The following reports shall be submitted to the Owner's Representative for information.

1. SCS Soil Survey for site.

2. Drillers logs to depth in local area.

3. Meeting notes with utility supervisor on surface-to-15-ft. (4.6 m) soils previously encountered in area (as applicable).

4. Site layout of loop, header, warning tape, installation locations and lengths.

5. In situ loop thermal test report.

6. Purge pump specifications.

-- End of Section --

SECTION 15521

GEOTHERMAL HEAT PUMP AND LOOP PIPING SYSTEMS (HIGH DENSITY POLYETHYLENE)

PART 1 GENERAL

1.1 SECTION INCLUDES:

HDPE pipe used for geothermal heat pump water loop installations.

1.2 RELATED SECTIONS

A. Section 15050, Basic Mechanical Materials and Methods.

B. Section 15181, Hydronic Water Piping Systems.

C. Section 15520, Exterior Ground Loop Heat Exchangers

1.3 REFERENCE STANDARD

A. ASTM D1683-98, Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.

B. ASTM D2447-99, Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.

C. ASTM D2513-99, Standard Specification for Thermoplastics Gas Pressure Pipe, Tubing and Fittings.

D. ASTM D2683-98, Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-controlled Polyethylene Pipe and Tubing.

E. ASTM D2837-98a, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.

F. ASTM D3261-97, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

G. ASTM D3035-95, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.

H. ASTM D3350-98a, Standard Specification for Polyethylene Plastics Pipe and Fitting Materials.

I. ASTM F714-97, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

J. ASTM F1055-98, Standard Specification for Electrofusion Type Polyethylene Fitting for Outside Diameter Controlled Polyethylene Pipe and Tubing.

1.4 SUBMITTALS FOR APPROVAL

A. Submit manufacturer's technical product data and installation instructions for pipe and fittings.

B. Submit names and certificates of successful completion of manufacturer training for the application specified.

C. Submit manufacturer's technical data on fusion machine to be used in joining the pipe and fittings.

D. Copies of pipe and fitting warranties must be submitted.

PART 2 PRODUCTS

2.1 MATERIALS: Material Description- ASTM D3350-Type III, Grade PE34

A. Pipe: The pipe shall be virgin resin with an allowance for on-site manufacturer re-processed resin. No recycled resin shall be used. All pipe and heat-fused materials shall be manufactured from a virgin polyethylene extrusion compound material in accordance with ASTM D-2513, Sections 4.1 and 4.2. The material shall maintain a 1600 psi (110.316 Bar) Hydrostatic Design Basis at 73.4o F (23.5 o C) per ASTM D-2837, and shall be listed in PPI TR4 as a PE3408 piping formulation. The material shall be a high density extrusion compound having a cell classification of PE345434, PE355434, or PE345534 with a UV stabilizer of C, D, or E as specified in ASTM D-3350 with the following exception: this material shall exhibit zero failures (F0) when tested for a minimum of 192 hours under ASTM D-1693, Condition C, as required in ASTM D-3350.

1. Pipe shall be manufactured to outside diameters, wall thickness, and respective tolerances as specified in ASTM D-3035 or D-2447. Molded fittings(White/Drisco) shall be manufactured to dimensional specifications and requirements of (White/Drisco) ASTM D-2683 for socket fittings, ASTM D-3261 for butt/sidewall fittings, ASTM D-2513, Section 6.10.1 for Mechanical Stab fittings, and ASTM F-1055 for electrofusion fittings.

a) Pipe with a diameter of 1.252 inches or less (3.175 cm) (nominal) shall be manufactured in accordance with ASTM D-3035 with a minimum based on pressure rating dimension ratio of 11.

b) Pipe manufactured with a diameter of 1.253 inches (3.175 cm) (nominal) and larger shall be manufactured in accordance with ASTM D-3035 and ASTM F714 with a minimum based on pressure ratingdimension ratio of 15.5, or ASTM D-2447 Schedule 40. If the pipe is used in a vertical bore application, it shall be manufactured in accordance with ASTM D-3035 with a minimum based on pressure rating dimension ratio of 11.

2. Factory- shipped U-bend assemblies shall be sealed and under air pressure.

B. Fittings: The geothermal system pipe fittings which are molded shall be manufactured to the dimensional specifications and requirements of ASTM D-3261 for butt/sidewall fittings. The material used in the manufacturing of the fitting shall be the same approved extrusion material as the connecting pipe. For fabricated fittings, a minimum 'quick-burst' strength of the fittings shall not be less than that of the pipe, nor less than four times the long-term water-rated working pressure.

1. Purpose-designed U-bend fittings shall be used instead of L+Street for ease of insertion. Manufacturers include Phillips and Enlink.

C. Joints: The approved joints are heat fusion, transition fittings and proof-tested. Fusion joints shall be made by trained and qualified construction crew staff. The butt fusion machine used to make the joints shall encompass the following features:

1. Guide rods shall be in a plane that passes through the centerline of the pipe, thus canceling the bending forces in the machine caused by the fusion forces.

2. The pipe clamps shall have the strength to 'round-up' the pipe close to the fusion joint. They must be adjustable for removal of high/low mismatch of pipe walls and clamp each piece on continuing straight centerline.

3. The pipe facing device shall be capable of rapid facing of the pipe ends to a perfectly flat surface, so when the ends are brought together, there is 100 percent plastic contact.

4. The facer may be hand or electric powered for pipe sizes up to 2 inches (5.1 cm), and electrically powered for pipe sizes up to 8 inches (20.3 cm).

5. The facer shall have precisely machined stops to lock the facer squarely between the clamping jaws at the end of the face off.

6. The heater plate shall be electrically heated and thermostatically controlled. The surface shall be smooth with a high quality non-stick coating. The heater shall be capable of quick heat-up and maintaining a constant surface temperature in the desired temperature range even in inclement conditions. The heater plate shall be equipped with a thermometer to indicate temperature change. A surface pyrometer is used periodically to assure proper temperature. Use pipe manufacturer's recommended fusion temperature.

7. The socket fusion machine used to make the joints shall encompass the following features:

a) An electric, thermostatically-controlled heater plate. The surface shall be smooth and free of foreign material. The heating tool shall be capable of heating socket faces to the appropriate fusion temperatures as per manufacturer's recommendations.

b) A set of metal socket faces which are dimensionally accurate according to current industry practices. The surface of the socket face that will be in direct contact with the pipe or fitting shall be smooth and coated with a high quality non-stick coating.

c) Temperature-indicating crayons or a surface pyrometer. One temperature crayon shall be for the proper 'low' end temperature indication and another crayon shall be for indicating the 'high' end temperature. Use pipe manufacturer's recommended fusion temperature range.

d) A depth gauge that is sized according to pipe diameter and corresponding fusion fitting socket depth. The depth gauge shall be used to locate the cold ring the proper distance from the pipe end.

e) A metal locking cold ring clamp which supplies support for the entire circumference of the piping material. Cold ring shall have the ability to keep the pipe end round. The cold ring shall be used to limit the pipe depth entry into the socket face and fusion fitting socket.

f) A timing device that emits an audible tone and a timing light on one second intervals. Timer shall be used to determine proper heat cycle for the pipe and fitting. Use pipe manufacturer's recommended heating times.

g) A number of clean, dry, 100 percent cotton rags used to clean the socket heater faces after each fusion application. Rags shall be free of any cleaning solvents, grease, or dirt.

8. Install piping in accordance with manufacturer's written instructions. The pipe and fittings must be joined using the butt, socket, electrofusion, or fusion process. No other method is acceptable. The vertical loop take-off tee fittings may be made using tees or the saddle fusion process on header piping 1.25 inch (3.18 cm) and above. Exercise extreme caution to completely remove the cutout on saddle tees. Bell reductions shall be used at all pipe reductions to eliminate trapped air.

9. Use reducing socket tees when fabricating socket type reducing headers. Consult with manufacturer for available fittings and fabricated headers.

10. Avoid sharp bends in piping. Consult pipe manufacturer for minimum bend radius. Install elbow fittings for bends which require tighter radii than manufacturer recommends. Use only continuous pipe in sharp bends.

D. Marking: Each pipe shall be permanently indent marked with the manufacturer's name, nominal size, pressure rating, relevant ASTM standards, cell classification number and date of manufacture.

1. Each fitting shall be identified with the manufacturer's name, nominal size, pressure rating, relevant ASTM standards and date of manufacturer.

2. Each pipe and factory-fitted "U-bend" vertical heat exchangers shall be permanently indent marked with distance in feet or meters from the U-bend tip, with marking every two feet or one meter.

E. Packaging, Handling, And Storage: The pipe and fittings shall be packaged, handled and stored in accordance with the approved manufacturer's general guidance and recommendations.

Table Of Water Pressure Ratings at 73.4oF (23.5oC) for DR-PR PE 3408 Plastic Pipe:

Dimension Ratio	Pressure Rating, psi	Pressure Rating, Bar
7	267	18.4
9	200	13.8
9.3	193	13.3
11	160	11.03
13.5	128	8.8
15.5	110	7.6
17	100	6.9

2.2 SOURCE QUALITY CONTROL

A. Obtain pipe and fittings from compatible manufacturers.

B. The pipe and fittings manufacturer shall have in place a functional quality assurance program. Such QC/QA programs shall deal with quality and workmanship, OA verification, OA rejection and have OA record retention systems in place.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install piping system per Section 15050, and drawing M6.

B. Join pipe and fittings by approved methods described above.

C. Pipe Supports

1. Space pipe supports per following table or per applicable manufacturer's instructions, if available:

Size (in.)	Maximum spacing
1.25	2 ft 9 in.
2	3 ft 0 in.
3	3 ft 6 in.
4	3 ft 9 in.

2. Remove sharp edges and burrs of hanger parts which contact pipe.

3. Do not rigidly clamp or force pipe into position by means of hangers.

4. Support vertical pipe with riser clamps. Restrict side motion by means of oversize Ubolts.

5. Verify metal location tape is used and working.

3.2 REPAIR/RESTORATION

A. Repair leaks found when testing by cutting out the damaged section and replacing it with an approved socket- or butt-fused piece (or approved mechanical connector). Large diameter polyethylene piping may be repaired by use of a torch.

3.3 FIELD QUALITY CONTROL

A. Pressure/Leak Test: Per manufacturer's instruction:

1. U-bend assembly before insertion.

2. U-bend assembly before circuit header installation.

3. Each circuit.

4. System at the vault or interior pump manifold.

3.4 CLEANING

A. Flush piping system with potable water at 2 fps and observe for free flow. The contractor must ensure there is not partial kinking, or crimping, either in the header or in the U-bend.

B. Remove material or obstructions that interfere with full flow.

C. Adjust piping to remove kinks or crimping in piping, U-bends, and header system.

-- End of Section --

SECTION 15522

THERMAL-ENHANCED BENTONITE GROUT

PART 1 GENERAL

1.1 SECTION INCLUDES:

Requirements for furnishing, mixing, and placing thermally-enhanced bentonite grout to seal and backfill each vertical u-bend well bore of the closed-loop ground heat exchangers to insure proper thermal contact with the earth and to ensure the environmental integrity of each vertical bore column. No other backfill material shall be accepted.

1.2 REFERENCES

A. National Ground Water Association - geothermal heat pump manual-Guidelines for the Construction of Vertical Boreholes for Closed Loop Heat Pump Systems

B. Local codes

INTERNATIONAL GROUND SOURCE HEAT PUMP ASSOCIATION (IGSHPA)

IGSHPA 21010	(1991) Grouting Procedures for Ground-Source Heat Pump Systems

1.3 SUBMITTALS

A. Manufacturer's published data sheets including thermal conductivity, permeability, percent solids, grout weight, linear shrinkage potential, maximum particle size and unit yield along with verification of the required listing.

1.4 QUALITY ASSURANCE

A. Grouting compound shall be certified and listed by National Sanitation Foundation International to ANSI/NSF Standard 60, "Drinking Water Treatment Chemicals - Health Effects".

PART 2 PRODUCTS

2.1 MANUFACTURER/PRODUCT

Grout Products:
Aquagard
Aquagrout
Black Hills Grout
Enviroplug
Groutwell
Puregold
Quick Grout
Volclay Grout

A. Grouting: Materials to be utilized by the Contractor shall be a minimum of 20% high sodium solids bentonite grout. The bentonite will be a slurry that will be tremie grouted from the bottom of the boring

to the surface in accordance with the IGSHPA 21010IGSHPA installation manual. The contractor will work quickly to assure that there are no air voids forming as a result of the bentonite placing.

B. Grouting material shall be Black Hills Bentonite's Thermal Grout Select as supplied by GeoPro, Inc. or equivalent which is pre-approved by the Owner or Owner's representative.

2.2 THERMAL CONDUCTIVITY

A. The thermal conductivity of the grouting compound must be 0.85 Btu/hr-ft-F or greater.

2.3 PERMEABILITY

A. The grout mixture shall also have a maximum permeability rate of less than 6.9 x 10 -8 cm/s as determined by using the "Falling-Head Method" (defined in the United States Army Corps of Engineers' Civil Engineering Manual No. EM 1110-2-1906, "Laboratory Soils Testing" as recommended by the U.S. Environmental Protection Agency to insure proper sealing. Permeability shall be verified by an independent testing laboratory with a copy of the report being supplied upon request from the Owner or Owner's representative.

2.4 TOTAL SOLIDS AND ENHANCEMENT COMPOUND PERCENTAGE

A. The thermally-enhanced bentonite grout used shall have a minimum manufacturers recommended mixture of 63.5% solids. The thermal enhancement compound (high-grade silica compound) shall constitute a minimum of 50% by weight of the aqueous slurry.

2.5 PACKAGING

A. Grouting materials shall be pre-manufactured and packaged prior to delivery to the job site.

PART 3 EXECUTION

3.1 MIXING

A. Thermally-enhanced bentonite grouting material shall be mixed according to manufacturers' written instructions.

B. Grout shall be mixed by a paddle type mixing device or by manufactured portable grouting unit specifically designed for the vertical ground heat exchanger industry. Jet mixing and re-circulation are not allowed for grout.

3.2 INSTALLATION

A. Grout material shall be pressure pumped through a 1 in., 1-1/4 in. or 1-1/2 in. inside diameter tremie pipe and placed in the bore column from the bottom to the top. Grouting process shall conform to the manufacturer's instructions. Completed grouted surface shall be placed at ground level to ensure complete fill of the bore column.

B. Contractor shall maintain a ready supply of spare grout pipes, hoses and fittings on the site.

C. A positive displacement pump shall be used for placing the grout in the borehole. Minimum pump suction and discharge lines shall be 3 inches and 1-1/2 inches respectively.

D. Drilling fluids shall be confined to the site and disposed of in accordance with prevailing local environmental regulations.

3.3 INSPECTION

A. Since some settling may occur after initial placement of the grout material, the Contractor shall monitor each borehole and continue adding grout as required for a period of no less than 30 minutes and no longer than 2 hours.

At a minimum, sampling shall be taken at the beginning of the project, at approximately one-third completion, and at approximately two-thirds completion. In the event that the analysis indicates a thermal conductivity value below the minimum specified value, corrective action shall be taken to increase the thermal conductivity value.

-- End of Section --

SECTION 15740

GROUND SOURCE HEAT PUMPS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1	(2001; various Errata) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A 527/A 527M	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality
ASTM B 117	(2002) Operating Salt Spray (Fog) Apparatus
ASTM C 1071	(2000) Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM D 1785	(2005) Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2466	(2002) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2564	(2004) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM G 21	(1996; R 2002) Determining Resistance of Synthetic Polymeric Materials to Fungi
ASTM G 22	(1976; R 1996) Determining Resistance of Plastics to Bacteria

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB TABES	(2005) Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2002) Installation of Air Conditioning and Ventilating Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1481	(1995; 6th Ed) HVAC Duct Construction Standards - Metal and Flexible

UNDERWRITERS LABORATORIES (UL)

UL 181	(2005) Factory-Made Air Ducts and Air Connectors
UL 555	(1999; Rev thru Jan 2002) Fire Dampers

1.2 SYSTEM DESCRIPTION

Control Diagrams shall be submitted for heat pump air conditioning systems showing the physical and functional relationship of equipment, electrical diagrams showing size, type, and capacity of the systems.

Contractor shall furnish labor, materials, equipment and services to construct, install, and test a system in accordance with the contract documents having the following design specifications:

	Outdoor	Indoor
Winter	15 degrees F DB	70 degrees F DB
Summer	95 degrees F DB 78 degrees F WB	75 degrees F DB 50 percent RH

1.3 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Connection diagrams shall be submitted indicating the relations and connections of the following items. Drawings shall indicate the general physical layout of all controls, and internal tubing and wiring details.

Heat Pump
Controls and Instrumentation

Control Diagrams shall be submitted in accordance with paragraph entitled, "System Description," of this section.

SD-03 Product Data

Heat Pump

Equipment and Performance Data shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

Manufacturer's catalog data shall be submitted for the following items in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Submit MSDS highlighting VOC content for each filed-applied

adhesive and solvent cement used in the building interior.

SD-06 Test Reports

Test reports shall be submitted for the following tests in accordance with the paragraph entitled, "Tests," of this section.

Pressure Tests
System Tests
Operating Tests

SD-07 Certificates

Certificates shall be submitted for the following showing conformance with the referenced standards contained in this section.

Heat Pump
Air-Diffusion Devices
Filters

SD-08 Manufacturer's Instructions

Manufacturer's Instructions for installation of heat pump air conditioning systems shall be submitted showing the manufacturer's recommended method and sequence of installation.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with paragraph entitled, "Operation and Maintenance," of this section.

1.4 GENERAL REQUIREMENTS

Equipment and Performance Data shall be submitted for heat pump air conditioning systems consisting of air capacities and distribution, efficiencies and operating pressures and temperatures.

Manufacturer's Standard Color Chips samples shall be submitted by the Contractor for heat air conditioning systems.

PART 2 PRODUCTS

2.1 MATERIALS

Spare parts lists and information shall be submitted meeting referenced standards within this section.

2.1.1 Ductwork Materials

2.1.1.1 Galvanized Steel Ductwork Materials

Steel ductwork shall be hot dip galvanized carbon steel of lock forming quality, with regular spangle type zinc coating conforming to ASTM A 527/A 527M, G-90. Construction, metal gauge and reinforcement thickness shall conform to SMACNA 1481.

2.1.1.2 Flexible Duct

Wire reinforced flexible duct runouts to air outlets shall consist of a factory fabricated chloroprene or vinyl impregnated and coated fibrous glass cloth bonded to and supported by a corrosion protected spring steel helix. Fabric may be a laminate of metallic film and fibrous glass. Runout shall not exceed 5 feet in length and shall comply with NFPA 90A and UL 181. Working pressure rating of ducting shall be not less than three times maximum system pressure, and temperature range shall be minus 20 to plus 175 degrees F.

2.1.2 Insulation - Ductwork and Pipe

Refer to Section 15080 "MECHANICAL INSULATION".

2.2 GROUND SOURCE UNITARY HEAT PUMP

Unit shall be certified as complying with provisions of ARI/ISO 13256-1. Minimum Energy Efficiency Ratio (EER) shall be 15.0. Rating shall be at unit medium speed. Refrigerant shall be non-CFC R410A.

2.2.1 General

Furnish and install ground source heat pumps, as indicated on the plans and specs. Equipment shall be completely assembled, piped and internally wired. Capacities and characteristics as listed in the schedule and the specifications that follow. Provide indicate heat pump from one of the following manufacturers:.

Climate Master
Trane
Florida Heatpumps
Water Furnace

2.2.2 Vertical Ground source Heat Pumps

Units shall be supplied completely factory built for an entering water temperature range from 20º to 120ºF. All equipment listed in this section must be rated and certified in accordance with American Refrigeration Institute/International Standards Organization (ARI/ISO). The units shall have ARI/ISO labels. All units shall be fully quality tested by factory run testing under normal operating conditions and water flow rates as described herein. Quality control system shall automatically perform via computer: triple leak check, pressure tests, evacuate and accurately charge systems, perform detailed heating and cooling mode tests, and quality cross check all operational and test conditions to pass/fail database. Detailed report card will ship with each unit displaying all test performance data. Note: If unit fails on any cross check, system shall not allow unit to be shiped. Serial numbers will be recorded by factory and furnished to contractor on report card for ease of unit warranty status. Units tested without water flow are not acceptable.

2.2.3 Basic Construction

Vertical Units shall have one of the following air flow arrangements: Left Return/Top Discharge, Right Return/Top Discharge, Left Return/Bottom Discharge, Right Return/Bottom Discharge as shown on the plans.

All units (vertical) must have a minimum of three access panels for serviceability of compressor compartment.

Compressor section interior surfaces shall be lined with 1/2 inch thick, dual density, 1-3/4 lb/ft3 acoustic type glass fiber insulation. Air handling section interior surfaces shall be lined with 1/2 in thick, single density, 1-3/4 lb/ft3 foil backed fiber insulation suited for cleaning. Insulation placement shall be designed in a manner that will eliminate any exposed edges to prevent the introduction of glass fibers into the sir stream. Units without foil backed insulation or incapsulation in the air handling section will not be accepted.

The heat pumps shall be fabricated from heavy gauge G90 galvanized steel with powder coat paint finish, on both sides.

Standard cabinet panel insulation must meet NFPA 90A requirements, air erosion and mold growth limits of UL 181, stringent fungal resistance test per ASTM C 1071 and ASTM G 21, and shall meet zero level bacteria growth per ASTM G 22.

All units to have factory installed 1" discharge air duct collars, 2" filter racks with 2" filters (MERV 8) factory installed. Refer to Section 01450 for additional details.

All units must have an insulated panel separating the fan compartment from the compressor compartment. Units with the compressor in the air stream are not acceptable. Units shall have a factory installed 1 inch wide filter bracket for filter removal from either side.

Cabinets shall have separate holes and knockouts for entrance of line voltage and low voltage control wiring. All factory-installed wiring passing through factory knockouts and openings shall be protected from sheet metal edges at openings by plastic ferrules. Supply and return water connections shall be copper IPT fittings, and shall be securely mounted flush to the cabinet corner post allowing form connection to a flexible hose without the use of a back-up wrench. Water connections that protrude through the cabinet or require the use of a backup wrench shall not be allowed. All water connections and electrical knockouts must be in the compressor compartment corner post as to not interfere with the serviceability of unit. Contractor must ensure that units can be easily removed for servicing and coordinate locations of electrical conduit and lights with the electrical contractor.

2.2.4 Fan and Motor Assembly

Blower shall have inlet rings to allow removal of wheel and motor from one side without removing housing. The fan motor shall be a variable speed ball bearing type motor. The fan motor shall provide soft starting, maintain constant CFM over its static operating range and provide airflow adjustment on its control board. The fan motor shall be isolated from the housing by rubber grommets. The motor shall be permanently lubricated and have thermal overload protection. A special dehumidification mode shall be provided to allow lower airflows in cooling for better dehumidification. The dehumidification mode shall be selectable via a jumper on the control board or may be controlled externally from a humidistat. The fan motor on larger units (060&070) shall be isolated with flexible rubber type isolation grommets only. The fan and motor assembly must be capable of overcoming the external static pressures as shown on the schedule. Airflow/Static pressure rating of the unit shall be based on a dry coil and

50 percent filter in place. Ratings without filter, or on an ESP less than 0.25 in w.g. (6.35 mm w.g) are NOT acceptable.

2.2.5 Refrigerant Circuit

All units shall contain an HFC 410A sealed refrigerant circuit including a high efficiency scroll or rotary compressor designed for heat pump operation, a thermostatic expansion valve for refrigerant metering, an enhanced corrugated aluminum lanced fin and rifled copper tube refrigerant to air heat exchanger, reversing valve, coaxial (tube in tube) refrigerant to water heat exchanger, and safety controls including a high pressure switch, low pressure switch (loss of charge), water coil low temperature sensor, and air coil low temperature sensor. Access fittings shall be factory installed on high and low pressure refrigerant lines to facilitate field service. Activation of any safety device shall prevent compressor operation via a microprocessor lockout circuit. The lockout circuit shall be reset at the thermostat or at the contractor supplied disconnect switch.

Hermetic compressors shall be internally sprung. The compressor shall have a dual level vibration isolation system. The compressor will be mounted on computer selected vibration isolation springs to a large heavy gauge compressor mounting tray plate, which is then isolated from the cabinet base with rubber grommets for maximized vibration attenuation. Compressor shall have thermal overload protection. Compressor shall be located in an insulated compartment away from air stream to minimize sound transmission. Refrigerant to air heat exchangers shall utilize enhanced corrugated lanced aluminum fins and rifled copper tube construction rated withstand 625 PSIG refrigerant working pressure. Refrigerant to water heat exchangers shall be of copper inner water tube and steel refrigerant outer tube design, rated to withstand 625 PSIG working refrigerant pressure and 500 PSIG working water pressure.

Refrigerant metering shall be accomplished by thermostatic expansion valve only. Expansion valves shall be dual port balanced types with external equalizer for optimum refrigerant metering. Units shall be designed and tested for operating ranges of entering water temperatures from 20º to 120ºF (-6.7º to 43.3ºC). Reversing valve shall be four-way solenoid activated refrigerant valve, which shall default to heating mode should the solenoid fail to function. If the reversing valve solenoid defaults to cooling mode, an additional low temperature thermostat must be provided to prevent over-cooling an already cold room.

2.2.6 Drain Pan

The drain pan shall be constructed of 304 Stainless Steel to inhibit corrosion. This corrosion protection system shall meet the stringent 1000 hour salt spray test per ASTM B 117. If plastic type material is used, it must be HDPT (High Density Polyethylene) to avoid thermal cycling shock stress failure over the lifetime of the unit. Drain pan shall be fully insulated. Drain outlet shall be located at pan as to allow complete and unobstructed drainage of condensate. The unit as standard will be supplied with solid-state electronic condensate overflow protection.

Vertical units shall be furnished with a PVC slip condensate drain connection and an internal factory installed condensate trap.

2.2.7 Electrical

A control box shall be located within the unit compressor compartment and

shall contain a 50VA transformer, 24 volt activated, 2 or 3 pole compressor contactor, terminal block for thermostat wiring and solid-state controller for complete unit operation. Reversing valve and fan motor wiring shall be routed through this electronic controller. Units shall be name-plated for use with time delay fuses or HACR circuit breakers. Unit control shall be 24 Volt and provide heating or cooling as required by the remote thermostat/sensor.

2.2.8 Controls Multiple Protocol Control Interface System

Units shall have a Multiple Protocol interface board. Available protocols are BACnet MS/TP, Modbus, or Johnson Controls N2. The choice of protocol shall be field selectable/changeable via the use of a simple selector switch. Protocol selection shall not require any additional programming or special external hardware or software tools. This will permit all units to be daisy chain connected by a 2-wire twisted pair shielded cable. the following points must be available at a central or remote computer locations:

a. Space temperature
b. Leaving water temperature
c. Discharge air temperature
d. Command of space temperature setpoint
e. Cooling status
f. Heating status
g. Low temperature sensor alarm
h. Low pressure sensor alarm
i. High pressure switch alarm

2.2.9 Controls

Solid state control system shall communicate with thermostat to display (at the thermostat) the unit status, fault status, and specific fault condition, as well as retrieve previously stored fault that caused unit shutdown. The Remote Service Sentinel allows building maintenance personnel or service personnel to diagnose unit from the wall thermostat. The control board shall provide a signal to the thermostat fault light, indicating a lockout. Upon cycling the G(fan) input 3 times within a 60 second time period, the fault light shall display the specific code as indicated by a sequence of flashes. A detailed flashing code shall be provided at the thermostat LED to display unit status and specific fault status such as over/under voltage fault, high pressure fault, low pressure fault, low water temperature fault, condensate overflow fault, etc.

2.2.9.1 Thermostats

The thermostat shall be a electronic type thermostat as selected below with the described features:

a. Multistage digital Automatic Changeover (ATA22U01)
Thermostat shall be multi-stage (2H/2C), manual or automatic changeover with HEAT-OFF-COOL-AUTO system settings and fan ON-AUTO settings. Thermostat shall have an LCD display with temperature set-point(s), mode, and status indication. The temperature indication shall be selectable for ^{o}F or ^{o}C. The thermostat shall provide permanent memory of set-point(s) without batteries. A fault LED shall be provided to indicate specific fault condition(s). Thermostat shall provide temperature display offset for custom applications. Thermostat shall allow unit to provide better dehumidification with optional DM controller, by automatically shifting to

high speed fan on stage 2 cooling.

2.2.10 Warranty

Warranty equipment for a period of 12 months from start up or 18 months from shipping. Provide extended 4-year compressor warranty covers compressor for a total of 5 years.

2.3 DUCTWORK COMPONENTS AND ACCESSORIES

2.3.1 Flexible Connectors

Connectors shall be UL listed, 20 ounce, fire-retardant, airtight, woven fibrous glass cloth impregnated with chloroprene. Clear width, not including clamping section, shall be 3 to 5 inches.

2.3.2 Dampers

Manual volume damper construction shall conform to SMACNA 1481, unless otherwise specified. Damper shall be equipped with an indicating quadrant regulator, with a locking feature externally located and easily accessible for adjustment. Where damper rod lengths exceed 30 inches, a quadrant regulator shall be provided at each end of the damper shaft.

NFPA 90A fire dampers, constructed and labeled in accordance with UL 555 shall be provided at firewall barriers as indicated. For link loads in excess of 20 pounds, UL-approved quartzoid links shall be provided.

2.4 FILTERS

Filters shall be a 1 inch thick panel, installed in a filter box at the air handler for such purpose or installed in a return air filter grille and must be easily replaceable having throw away frames and media, standard dust holding capacity, and 350 feet per minute (fpm) maximum face velocity.

Filters shall have a minimum MERV value of 8. Filters installed after construction is complete and immediately prior to occupancy shall have a MERV value of 8.

2.5 PIPE, VALVES AND SPECIALTIES

2.5.1 Pipe

2.5.1.1 Polyvinyl Chloride (PVC) Pipe

PVC pipe shall be Schedule 40, and conform to ASTM D 1785.

Fittings shall be Socket Type, Schedule 40, PVC material conforming to ASTM D 2466.

Solvent cement for pipe and fittings shall conform to ASTM D 2564. Thread lubricant shall be as recommended by manufacturer of pipe and fittings.

Solvent cement shall have a VOC content not to exceed 510 g/l.

2.6 VIBRATION ISOLATION PROVISIONS

Equipment vibration isolation shall be as recommended by the equipment manufacturer.

Rubber shall be natural rubber. Elastomer shall be chloroprene. Shore A durometer measurement of both materials shall range between 40 and 60.

2.7 CONTROLS AND INSTRUMENTATION

Automatic temperature and humidity control systems shall include all equipment, instruments, and accessories required for proper operation. Controls may be electric, pneumatic, electronic, or any combination thereof. Thermostat shall be low voltage type with Fan Auto-Off and Heat-Off-Cool settings for heating and cooling temperature control. Thermostat location shall be as indicated. Thermostat shall conform to requirements established by ASHRAE 90.1, 2004.

Duct humidistats shall be insertion, proportioning type, reverse acting, with adjustable minimum throttling range no greater than 2 percent relative humidity, and shall be capable of maintaining relative humidity within this range for relative humidity of 20 to 80 percent and temperatures to 150 degrees F.

2.8 COATINGS

Finish coating for cellular elastomer insulation shall be a polyvinyl chloride lacquer approved by the insulation manufacturer.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment shall be installed in accordance with manufacturer's printed instructions and recommendations.

Except where shown in dimensional detail, exact locations of mechanical equipment, ducts, and piping are not shown on design drawings. Materials, including offsets, bends, elbows, or other elements that may be required for the work shall be provided and installed by the Contractor, subject to approval by the Engineer.

Brass or Aluminum identification tags carrying manufacturer's name, address, equipment type or style, catalog number or model, and serial number, shall be securely attached to major equipment components.

3.2 VIBRATION ISOLATION

Air conditioning equipment shall be vibration isolated from building structure using vibration isolators and from connecting ductwork using flexible connectors as specified.

3.3 TESTS

Entire system shall be tested and balanced per NEBB TABES to provide specified quantities of air, plus or minus 10 percent, and to ensure that each piece of equipment and each system operates in accordance with the manufacturer's instructions.

Fire dampers shall be tested for proper operation, by activating fusible link with localized heat.

The HVAC system, when properly installed, shall be tested and balanced per

NEBB TABES to deliver air flows from each supply register within 10 percent of design specification.

Final test reports shall be provided to the Owner's Representative. Reports shall have a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Report.

Pressure Tests, System Tests and Operating Tests shall be performed.

3.4 OPERATION AND MAINTENANCE

Contractor shall submit 6 copies of the Operation and Maintenance Manuals 30 calendar days prior to testing the heat pump air conditioning systems. Data shall be updated and resubmitted for final approval no later than 30 calendar days prior to contract completion.

-- End of Section --

SECTION 15741

100% O.A. GROUND SOURCE HEATPUMP WITH ENERGY RECOVERY WHEEL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 527/A 527M	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2002) Installation of Air Conditioning and Ventilating Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1481	(1995; 6th Ed) HVAC Duct Construction Standards - Metal and Flexible

UNDERWRITERS LABORATORIES (UL)

UL 181	(2005) Factory-Made Air Ducts and Air Connectors

1.2 SYSTEM DESCRIPTION

Control Diagrams shall be submitted for heat pump air conditioning systems showing the physical and functional relationship of equipment, electrical diagrams showing size, type, and capacity of the systems.

Contractor shall furnish labor, materials, equipment and services to construct, install, and test a system in accordance with the contract documents having the following design specifications:

	Outdoor	Indoor
Winter	15 degrees F DB	70 degrees F DB
Summer	95 degrees F DB 78 degrees F WB	75 degrees F DB 50 percent RH

1.3 SUBMITTALS

Submit the following in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Connection diagrams shall be submitted indicating the relations and connections of the following items. Drawings shall indicate the general physical layout of all controls, and internal tubing and wiring details.

Heat Pump
Controls and Instrumentation

Control Diagrams shall be submitted in accordance with paragraph entitled, "System Description," of this section.

SD-03 Product Data

Equipment and Performance Data shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

Manufacturer's catalog data shall be submitted for the following items in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Heat Pump

SD-06 Test Reports

Test reports shall be submitted for the following tests in accordance with the paragraph entitled, "Tests," of this section.

Pressure Tests
System Tests
Operating Tests

SD-07 Certificates

Certificates shall be submitted for the following showing conformance with the referenced standards contained in this section.

Heat Pump
Filters

SD-08 Manufacturer's Instructions

Manufacturer's Instructions for installation of heat pump air conditioning systems shall be submitted showing the manufacturer's recommended method and sequence of installation.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with paragraph entitled, "Operation and Maintenance," of this section.

1.4 GENERAL REQUIREMENTS

Equipment and Performance Data shall be submitted for heat pump air conditioning systems consisting of air capacities and distribution, efficiencies and operating pressures and temperatures.

Manufacturer's Standard Color Chips samples shall be submitted by the

Contractor for heat pump air conditioning systems.

PART 2 PRODUCTS

2.1 MATERIALS

Spare parts lists and information shall be submitted meeting referenced standards within this section.

2.1.1 Ductwork Materials

2.1.1.1 Galvanized Steel Ductwork Materials

Steel ductwork shall be hot dip galvanized carbon steel of lock forming quality, with regular spangle type zinc coating conforming to ASTM A 527/A 527M, G-90. Construction, metal gauge and reinforcement thickness shall conform to SMACNA 1481.

2.1.1.2 Flexible Duct

Wire reinforced flexible duct runouts to air outlets shall consist of a factory fabricated chloroprene or vinyl impregnated and coated fibrous glass cloth bonded to and supported by a corrosion protected spring steel helix. Fabric may be a laminate of metallic film and fibrous glass. Runout shall not exceed 5 feet in length and shall comply with NFPA 90A and UL 181. Working pressure rating of ducting shall be not less than three times maximum system pressure, and temperature range shall be minus 20 to plus 175 degrees F.

2.1.2 Insulation - Ductwork and Pipe

Refer to Section 15080 "MECHANICAL INSULATION".

2.2 WATER SOURCE HEAT PUMP WITH ENERGY RECOVERY WHEEL

2.2.1 General

Furnish and install high efficient HFC-410A 100% OA Ground Source Heat Pumps, as indicated on the plans. Equipment shall be completely assembled, piped and internally wired. The unit shall include the following minimum components: Enthalpy energy recovery wheel, compressor(s), dehumidification/cooling coil, hot gas reheat coil, receiver, supply and exhaust air blowers, blower motors, controls and water cooled condenser and heat pump evaporator. Units shall have Variable Hot Gas Reheat and leaving air temperature control to ±0.2ºF (±0.1ºC) in cooling/dehumidification and heating modes. Capacities and characteristics shall be as listed in the schedule and the specifications that follow. Provide indicated Heatpump from one of the following manufacturer's:

Climate Master
Trane
Engineered Air
Des Champs

2.2.2 Horizontal 100% OA Ground Source Heat Pumps

Units shall be supplied completely factory built for an entering water temperature range from 30° to 100°F (-6.7° to 43.3°C) as standard. All equipment listed in this section must be tested in accordance with American

Refrigeration Institute / International Standards Organization (ARI / ISO) and certified in accordance with UL 1995 Second Edition. The units shall have an ETL-US label. All units shall be fully quality tested by factory run testing under normal operating conditions and water flow rates as described herein. The following quality control system checks shall be performed: triple leak check, pressure tests, evacuate and accurately charge system, perform detailed heating, dehumidification and cooling mode tests, and hot gas reheat mode testing. Units tested without water flow are not acceptable.

2.2.3 Basic Construction

The cabinet shall be 1" double wall construction, 16-gauge galvaneal outer panels and 22-gauge galvanized metal inner liner. The unit shall be ETL or UL tested to withstand UL rain test standards. A 12-gauge galvanized base rail assembly shall be incorporated with the unit base pan for the base of the unit.

All exterior and other painted surfaces shall be constructed of galvaneal steel with a power coated painted finished. Painting shall be by a powder coat technique to assure positive adherence with a high-impact finish. All sides of panels shall be painted. The panels shall be rated to meet a minimum of 1,000-hour salt spray test. Unit color shall be light gray. This corrosion protection system shall meet the stringent 1000-hour salt spray test per ASTM B117.

Unit shall be single side access. Access to filters, indoor blower, electrical controls, compressor compartment, and damper section shall be provided by double wall access doors with hinges, and compression latches with non-corrosive handles. All external fasteners shall be stainless steel bolts. Self-tapping or drive screws are unacceptable.

Bottom base pan of entire unit shall have no penetrations by bolts or screws.

All double wall cabinet panels shall house a 1 inch thick, solid foam insulation with a minimum "R" factor of 5.0.

Entire unit base shall be insulated on the underneath side to provide condensation protection, and noise attenuation.

The unit shall be furnished with 4" filter racks on both sides of the ERW and one set 4" MERV 8 pleated filters.

2.2.4 Enthalpy Energy Recovery Wheel

Desiccant Type: Wheel shall be a 4-Angstrom (0.4 nm) or smaller molecular sieve made of porous crystalline aluminosilicates.

Wheel Type: Constructed of a corrugated synthetic fiber-based media impregnated with the desiccant. Desiccant that is bonded or coated to the matrix shall not be acceptable.

Wheel Frame: Constructed of galvanized spokes and an aluminum hub

Drive System: The motor shall be a fractional horsepower AC drive with a durable multi-link drive belt

Purge: The system shall have an adjustable (0 to 15%) purge section to

minimize contaminant carryover

2.2.5 Supply and Exhaust Fan and Motor Assemblies

The assembly shall include a fan, housing and solid steel fan shaft encased in ball bearings. Unit shall have a belt drive fan assembly, fan pulley and adjustable motor sheave with v-belt drive. Fan shall be forward curved, low speed centrifugal that has been statically and dynamically balanced, and tested in accordance with current A.M.C.A. standards bulletin 210. Fan bearings shall be permanently lubricated type and be self-aligning. The motor shall be a three-phase, high efficiency, ball bearing, open type with internal thermal overload protection. The motor shall be mounted on an adjustable base for proper belt tension. The fan and motor assembly must be capable of overcoming the external static pressures as shown on the schedule. Airflow / Static pressure rating of the unit shall be based on a wet coil and a clean filter in place. Fan and motor assembly will be mounted on an easily removable slide out assembly for easy access and maintenance; motor shall be factory wired with wire of sufficient length to allow fan/motor assembly to be removed from unit and be placed on roof of unit for servicing.

2.2.6 Refrigerant Circuit

Units shall have a sealed refrigerant circuit including a high efficiency HFC-410A scroll compressor(s) designed for heat pump operation, a thermostatic expansion valve for refrigerant metering, an enhanced corrugated aluminum lanced fin and rifled copper tube refrigerant to air heat exchanger, plate refrigerant to water heat exchanger, plate water to refrigerant evaporator, hot gas reheat / heat pump heating coil, liquid receiver, modulating HGRH controls and safety controls including a high pressure switch, low pressure switch (loss of charge), water coil low temperature sensor, and air coil low temperature sensor. The unit shall be provided with a refrigerant receiver. The receiver will assist the unit in operating at the highest efficiency over the entire operating range of load conditions.

Access fittings shall be factory installed on high and low pressure refrigerant lines to facilitate field service. Activation of any safety device shall prevent compressor operation via a microprocessor lockout circuit. The lockout circuit shall be reset at the contractor supplied disconnect switch.

2.2.7 Evaporator Dehumidifier Coil

Fins shall be die formed, lanced, aluminum with extruded fin collars to provide maximum heat transfer, and shall be damage resistant. Fin spacing shall be 10 FPI (fins per inch). Coil tubing shall be fabricated from seamless drawn copper. The inner tubing shall be rifled to produce turbulent refrigeration flow and to enhance the heat transfer process. The tubes shall be hydraulically expanded into the fins to form a permanent metal-to-metal bond for maximum heat transfer and stability. The coil shall be six (6) rows deep. All air coils shall be leak tested with 625-psig nitrogen. After testing, coils must be sealed.

2.2.8 Condenser (Reheat Coil)

The reheat coil shall be positioned with a 5" (127 mm) minimum clearance from the DX coil to avoid water re-evaporation. Direct connection of the reheat coil to the DX coil is not allowed. Fins shall be die-formed,

aluminum with extruded fin collars to provide maximum heat transfer, and shall be damage-resistant. Fin spacing shall be 12 FPI (fins per inch). Coil tubing shall be fabricated from seamless drawn copper. The tubes shall be hydraulically expanded into the fins to form a permanent metal-to-metal bond for maximum heat transfer and stability. The coil shall be a minimum of two (2) rows deep. All air coils shall be leak tested with 625-psig nitrogen. After testing, coils must be sealed.

2.2.9 Water Condenser and Water to Refrigerant Evaporator

Unit(s) shall be equipped with two (2) brazed plate water to refrigerant heat exchangers. The plate water to refrigerant evaporator shall be piped in series with the water condenser. The water condenser must be first in series with respect to incoming water flow from the water loop. The water to refrigerant condenser allows the refrigerant energy to be released into the water loop during cooling operation and it also shall operate as a condenser in the heat pump heating mode to discharge any overage of compressor energy generated and not needed to control unit Leaving Air Temperature (LAT). In the heat pump heating mode the excess of refrigerant energy will discharged into the water loop and acts as a water heating "supercharger" heating the water before the water to refrigerant evaporator extracts the energy for heating (heat of extraction). This process is patented.

The system shall be designed for simultaneous heat of rejection to both the hot gas reheat coil and the water condenser while controlling the LAT within ±0.2°F (±0.1°C).

The plate water to refrigerant evaporator and the plate refrigerant to water condenser shall both be constructed as a brazed plate heat exchanger. The heat exchanger shall consist of stainless steel plates, copper-brazed together to allow a maximum working temperature of 350°F. The heat exchanger shall be factory leak-tested with helium at 625 psig for quality assurance and, must have a maximum working pressure of 450 psi. The brazed plate heat exchangers shall be UL listed.

The head pressure shall be controlled by the system's internal flooding valve.

2.2.10 Compressor(s)

Compressors: (3 to 5 HP): The compressor shall be a heavy-duty scroll-type, single compressor complete with start kit on single-phase motors. The compressor shall be equipped with low- and high-pressure safety switches, with internal protection from overheating. The compressors shall be externally vibration isolated. A standard factory two (2)-year compressor warranty shall be included. The unit must include hot gas bypass for each system compressor.

Compressors: (8 to 30 HP): The compressors shall be a tandem pair, heavy-duty scroll-type. A factory-mounted sensor that will deactivate one compressor when the load reaches the mid-range of the system's capacity, shall stage the compressors. The compressors must be equipped with high- and low-pressure safety switches, with internal protection from overheating. The compressors shall be externally vibration isolated. A standard factory two (2)-year compressor warranty shall be included. The unit must include hot gas bypass for each system compressor.

2.2.11 Drain Pan

The drain pan shall be 20-gauge (0.812 mm) stainless steel, sloped, and positioned under the evaporator coil. It shall be silver-soldered, welded and securely attached to the evaporator end plates to avoid shifting. The drain pan shall be fitted with a minimum 1" EPT non-corrosive plastic drain connection and an internal P-Trap. The drain pan shall meet all the requirements of ASHRAE 62. Drain pan shall be fully insulated. Drain outlet shall be located at the pan as to allow complete and unobstructed drainage of condensate.

2.2.12 Electrical

The electrical control panel shall be easily accessible on one side so that all service can be performed from the side of the unit. It shall be of adequate size so as to house all electrical controls and devices.

The unit shall be provided with single-point power connection, factory wired to the power connection lug set.

The electrical controls shall include low voltage transformers to supply 24 VDC control power, clearly labeled high- and low-voltage terminal strips, high- and low-pressure control (with manual reset of the high-pressure cutout and automatic reset of low pressure cutout), and an anti-shortcycling timer delay to protect against compressor cycling.

2.2.13 Controls

The unit shall include factory mounted temperature and humidity sensors in the filter section, pre-wired to controller in panel for actuation of compressor in ambient temperatures above 55°F (12.7 °C) dew point (programmable).

The unit must be supplied with the necessary controls as defined in the Sequence of Operation for proper temperature and humidity control of the space. See plans for the detailed sequence of operation of this unit.

All Controller must be factory installed and wired.

2.2.14 Warranty

Warranty equipment for a period of 12 months from start up or 18 months from shipping (which ever occurs first).

Extended 4-year compressor warranty covers compressor for a total of 5 years

PART 3 EXECUTION

Not Used.

-- End of Section --

SECTION 15810

DUCTWORK AND DUCTWORK ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL(AMCA)

AMCA 500-D	(1998) Laboratory Methods of Testing Dampers for Rating
AMCA 501	(2003) Application Manual for Air Louvers

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M	(2001a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C 553	(2002) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM E 437	(1992; R 1997) Industrial Wire Cloth and Screens (Square Opening Series)
ASTM E 96	(2000e1) Water Vapor Transmission of Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2002) Installation of Air Conditioning and Ventilating Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA HVAC Duct Const Stds	(1995, 2nd Ed) HVAC Duct Construction Standards - Metal and Flexible
SMACNA Seismic Restraint Mnl	(1998, 2nd Ed) Seismic Restraint Manual: Guidelines for Mechanical Systems

UNDERWRITERS LABORATORIES (UL)

UL 181	(2005) Factory-Made Air Ducts and Air Connectors
UL 555	(1999; Rev thru Jan 2002) Fire Dampers
UL 555S	(1999; Rev thru Apr 2003) Smoke Dampers

UL 723	(2003) Test for Surface Burning Characteristics of Building Materials

1.2 RELATED REQUIREMENTS

Section 15050 BASIC MECHANICAL MATERIALS AND METHODS, applies to this section with the additions and modifications specified herein.

1.3 PRESSURE CLASSIFICATION

SMACNA HVAC Duct Const Stds, Section 1, and as indicated.

1.4 SYSTEM DESCRIPTION

Provide ductwork systems including ductwork, ductwork hangers and supports, equipment, materials, installation, workmanship, fabrication, assembly, erection, and inspection, shall be in accordance with SMACNA HVAC Duct Const Stds as modified and supplemented by the specifications and drawings.

1.4.1 Design Requirements

1.4.1.1 Duct Span Versus Reinforcement Schedule

Submit maximum duct dimension, board stiffness rating, board thickness, type and spacing of reinforcement, and maximum duct static pressure.

1.4.1.2 Automatic Dampers

Submit certification of damper leakage testing and conformance with AMCA 500-D and specified maximum leakage or pressure drop requirements.

1.4.1.3 Sound Pressure Level Rating

Submit for inlets and outlets including diffusers, registers and grilles.

1.5 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Dampers (Manual and Control)

Fire dampers

Flexible ducts and connectors

Bird screens

Diffusers, registers, and grilles

Metal ducts

Duct Sealant

Submit MSDS highlighting VOC content for each filed-applied

adhesive and sealant used in the building interior.

1.6 QUALITY ASSURANCE

1.6.1 Modification of References

SMACNA Duct Construction Manuals: The SMACNA recommendations shall be considered as mandatory requirements. Substitute the word "shall" for the word "should" in these manuals.

1.6.2 Ductwork and Ductwork Accessories

Submit manufacturer's instruction including job inspection checklist, methods of on-site storage and handling, and recommended repair methods.

PART 2 PRODUCTS

2.1 METAL DUCTS

2.1.1 Steel Ducts

ASTM A 653/A 653M galvanized steel sheet, lock-forming quality; coating designation G90.

2.2 DUCTS OF PRESSURE CLASSES

Ducts of pressure classes 4 to 10 inch water gage. Construct ducts of galvanized steel.

2.2.1 Construction

Refer to the drawings for duct construction requirements.

Provide duct construction, metal gages, and hangers and support reinforcements. Ducts shall not pulsate or vibrate when in operation. Pressure sensitive tape shall not be used as a primary sealant on ductwork. Air leakage shall be less than one percent of the system capacity. Curved elbows shall have a centerline radius not less than 1 1/2 times the width of ducts.

2.2.2 Joints

Construct joints to meet the requirements of the leakage test specified. Duct components shall fit so that joints are not mismatched. Do not use duct sealant and tape to compensate for mismatched connections. Longitudinal locks or seams known as "button-punch snap-lock" will not be permitted. Apply fire-resistant sealing compound to exposed male part of fittings collars so that sealer will be on inside of joint and fully protected by the metal of the duct and fitting. Apply one brush coat of sealing compound over outside of joint to at least 2 inchband width covering screwheads and joint gap. When tape is used, apply a single wrap of a duct tape over the wet sealer. Tape provided shall be as recommended by the sealer manufacturer to permit proper curing of the sealer. Dents in the male portion of the slip fitting collar will not be acceptable.

All sealants applied on the interior of the building shall have a VOC content not more than 250 g/l.

2.2.3 Fittings

Provide square elbows, round elbows, fittings, branch take-offs, transitions, splitters, duct volume dampers, fire dampers, flexible connections, and access doors.

2.2.3.1 Test Holes

Provide factory fabricated, airtight, and noncorrosive test holes with screw cap and gasket. Provide extended neck fittings to clear insulation.

2.2.3.2 Round Elbows

Provide 45 degree and 90 degree elbows of 2 piece die stamped construction for ducts 8 inches or less in diameter. For ducts over 8 inches in diameter, provide 5 mitered piece for 90 degrees and 3 mitered piece for 45 degrees.

2.2.4 Round Ducts

Make joints between sections of duct and fittings with mating angle rings, beaded sleeve joints or slide-on gasketed flange connections. Slide-on gasketed flange joints shall consist of two mating flange rings. The flanges shall be fabricated with an integral mastic to make them self-sealing. The flanges shall be joined to the duct with spot-welds or self-tapping screws. A neoprene gasket shall be used between the flanges. Final joining of the slide-on flange connection shall be made with four bolts for flat-oval ducts. A single-bolt closure ring shall be used to complete the round slide-on flange connection.

2.2.5 Rectangular Ducts

Except as specified or indicated otherwise, make joints between sections of duct and between ducts and fittings with mating angle flange joints, other joints recommended in SMACNA HVAC Duct Const Stds, Section 1, or slide-on gasketed flange connections. Reinforce at the joints and between the joints. The slide-on gasketed flange connections shall consist of two mating flange frames. The frames shall be made up from four pieces of straight roll formed flange and four corner pieces. The flange shall be fabricated with an integral mastic to make them self sealing. The corner pieces shall be made with a downset to allow the corner of the duct to protrude past the corner piece. The frame shall be joined to the ductwall with spotwelds or self-tapping screws. A butyl gasket shall be used between the flanges. Gasket must pass UL 723 and shall not contain vegetable oils, fish oils or any other type vehicle that will support fungal and/or bacterial growth associated with dark areas of ductwork. The connection shall be completed using drive-on corner clips and snap-on cleat. Cleat spacing and fastener spacing shall be as dictated by the manufacturer. For joint systems , follow the manufacturer's construction and installation guidelines.

2.3 DUCTS OF PRESSURE CLASSES 3 INCH WATER GAGE OR LESS

Except as specified or indicated otherwise, construction, metal gage, hangers and supports, and reinforcements shall conform with SMACNA HVAC Duct Const Stds, except that ducts with pressure classifications below 2 inch water gage that are located outside of the conditioned space shall have a seal class C. Ductwork shall be airtight and shall not vibrate or pulsate when system is in operation. Pressure

sensitive tape shall not be used as a primary sealant on ductwork with pressure classifications above one inch water gage. Air leakage shall be less than 5 percent of the system capacity. Construct ductwork of galvanized steel.

2.3.1 Curved Elbows

Make a centerline radius not less than 1 1/2 times the width or diameter of the duct.

2.3.2 Laps

Make laps at joints in the direction of air flow. Space button-punch or bolt-connection in standing seams at fixed centers not greater than 6 inches. Longitudinal locks or seams, known as "button-punch snap-lock," may be used in lieu of Pittsburg Lock.

2.3.3 Fittings

Provide elbows, vaned elbows, take-offs, branch connections, transitions, splitters, volume dampers, fire dampers, flexible connections, and access doors. Provide factory fabricated airtight, and noncorrosive test holes with screw cap and gasket.

2.4 FLEXIBLE DUCTS AND CONNECTORS

UL 181, Class I, UL listed, and additional requirements herein specified. Provide to connect between rigid ducts and outlets or terminals. There shall be no erosion, delamination, loose fibers, or odors from the ducts into the air stream. At 250 degrees F, minimum rating pressures shall be 6 inches water positive and 1/2 inch negative, up to 4,000 fpm. Flexible ducts shall be maximum 6 feet in length. Minimum bend radius shall be twice the duct diameter.

2.4.1 Materials

Interlocking spiral or helically corrugated type constructed of corrosion-resistant steel.

2.4.2 Insulation and Vapor Barrier

ASTM C 553 Type 1, Class B-2, minimum one inch nominal thickness and three-quarter lb./cu. ft.density. Sheathe insulation with a vapor barrier having a maximum water vapor permeance of 0.20 perm in accordance with ASTM E 96, Procedure A. Coat ends of insulation with cement to prevent erosion and delamination.

2.4.3 Joints

Make airtight slip joints, seal with pressure-sensitive vapor-seal adhesive tape or duct sealer, and secure with sheet metal screws. To prevent insulation compression, place 2 inch wide by one inch thick closed cell foam plastic spacers over joints under vapor barriers. To provide a vaportight joint, provide a corrosion-resistant steel or aluminum clamp over such spacers.

All sealants applied on the interior of the building shall have a VOC content not more than 250 g/l.

2.5 DIFFUSERS, REGISTERS, AND GRILLES

2.5.1 Material and Finishes

Provide as scheduled on the drawings.

Provide factory-furnished diffusers, registers, and grilles constructed of steel or aluminum. Exterior and exposed edges shall be rolled, or otherwise stiffened and rounded. Steel parts shall be factory zinc phosphate treated prior to priming and painting or have a baked-on enamel finish. Colors shall be selected or approved by Architect/Engineer firm.

2.5.2 Ceiling Diffusers

Equip with baffles or other devices required to provide proper air distribution pattern as indicated. Except for linear diffusers, internal parts shall be removable through the diffuser neck for access to the duct and without the use of special tools.

2.5.2.1 Linear Diffusers

Joints between diffuser sections shall appear as hairline cracks. Provide alignment slots for insertion of key strips or other concealed means to align exposed butt edges of diffusers. Do not use screws and bolts in exposed face of frames or flanges. Frames and flanges exposed below ceiling shall be metal-filled and ground smooth. Furnish separate pivoted or hinged adjustable air-volume-damper and separate air-deflection blades.

2.6 DUCT SLEEVES, PREPARED OPENINGS, AND CLOSURE COLLARS

2.6.1 Duct Sleeves

Fabricate from minimum 20 gage galvanized steel. Where sleeves are installed in bearing walls, provide structural steel sleeves as indicated. Size sleeves to provide one inch clearance between duct and sleeve or between insulation and sleeve for insulated ducts.

2.6.2 Prepared Openings

Provide one inch clearance between the duct and the sleeve, or one inch clearance between insulation and sleeve for insulated ducts except at grilles, registers, and diffusers.

2.6.3 Packing

ASTM C 553, Type 1, Class B-2, mineral fiber.

2.6.4 Closure Collars

Four inches wide minimum, fabricated from minimum 20 gage galvanized steel.

2.7 DEFLECTORS

Factory-fabricated and factory- or field-assembled units consisting of curved turning vanes for uniform air distribution and change of direction with minimum turbulence and pressure loss. Provide curved vanes for square elbows. For round ducts taking off from rectangular ducts, provide factory fabricated, galvanized sheet metal, 45º fittings. These fittings shall have 45º TAP, butterfly dampers, and locking quadrant operators.

2.8 ACCESS DOORS

Door shall be rigid and airtight with neoprene gaskets and two or more chrome-plated steel hinges and quick fastening locking devices. Provide doors as large as practical. Mount doors, if possible, so that air pressure holds them closed. As an alternative, removable access doors may be used. These access doors shall be constructed from stamped sheet metal and consist of an inner and outer door panel. Where insulated doors are needed, the inner door shall consist of two panels spot-welded together which totally encapsulate fiberglass insulation. The inner and outer doors shall be joined by bolts and threaded handles in such a configuration that the panels can be drawn together to secure the door to the duct in a sandwich fashion. The handles shall be high impact plastic with threaded metal inserts. Conical springs shall be used between the door panels to facilitate installation and removal of the door. Neoprene gasket shall be used around the outside edge of the inner or outer panel, but not both, to seal the door. This type of door is approved for use on rectangular, round and flat-oval ductwork.

2.9 DAMPERS AND LOUVERS

Construct dampers and louvers with galvanized sheet metal two gages heavier than ducts in which installed. Except as modified herein, the construction shall be of aluminum or galvanized steel with interlocking edges and maximum 10 inch blade width. Dampers shall be opposed-blade type for control or where indicated. Damper blades shall be connected to the damper frame with a non-metallic anti-friction bushing. The blades shall be connected to the frame with a galvanized, zinc coated steel anti-friction bearing pin. The pin shall consist of a single or double row sealed, stainless steel, maintenance free, roller or ball bearing, lubricated for life with a full stroke test of 200,000 or more strokes in accordance with UL 555S. The bearing shall be pressed onto a steel shaft via a knurled stud. A slotted dowel pin is then inserted thru a hole connecting the two pins.

2.9.1 Backdraft Dampers (Gravity Dampers or Shutters)

Factory-fabricated, with statically balanced blades that open automatically when the fan starts and close by gravity when the fan stops. Provide the edges of blades with felt or rubber strips to prevent rattling.

2.9.2 Manual Volume Dampers

Balancing, factory-fabricated type. Equip dampers with accessible mechanism such as quadrant operators or 3/16 inch rods brought through the side of ducts with locking setscrew and bushing. Where quadrant operators are furnished, provide chrome plated or enamel painted type with exposed edges rounded.

2.9.3 Fire Dampers

Provide in accordance with UL 555. Rated same as installed wall's rating.

2.9.4 Automatic Dampers

Section 15910 DIRECT DIGITAL CONTROL SYSTEMS. Maximum leakage shall not exceed 10 cfm per square foot of damper face area at 2 inch w.g. pressure difference.

2.9.5 Bird Screens

ASTM E 437, general industrial-use wire cloth, Grade C, medium light or heavier, nominal 2 mesh 0.063 inch wire diameter, aluminum bird screens. Provide removable insect screens of grooved type, with vinyl or neoprene spline insert for securing screen cloth.

PART 3 EXECUTION

3.1 INSTALLATION

Except as specified or indicated otherwise, conform to NFPA 90A, SMACNA HVAC Duct Const Stds. Provide mounting and supporting of ductwork and accessories including, but not limited to, structural supports, hangers, vibration isolators, stands, clamps and brackets, access doors, and dampers. Provide electrical isolation between dissimilar metals. Electrical isolation may be fluorinated elastomers or sponge-rubber gaskets. Install ductwork accessories as indicated and as recommended by manufacturer's printed instruction. Allow clearance for inspection, repair, replacement, and service. Louvers in accordance with AMCA 501.

3.1.1 Ductwork

Air distribution systems shall operate with no chatter or vibration.

3.1.1.1 Field Changes to Ductwork

Those required to suit the sizes of factory-fabricated equipment actually furnished, shall be designed to minimize expansion and contraction. Use gradual transitions in field changes as well as modifications to connecting ducts.

3.1.1.2 Dampers

When installed on ducts to be thermally insulated, equip each damper operator with stand-off mounting brackets, bases, or adapters to provide clearance between the duct and operator not less than the thickness of insulation. Stand-off mounting items shall be integral with the operator or standard accessory of damper manufacturer. Paint handle orange before duct insulation is applied.

3.1.1.3 Deflectors

Provide in square elbows, duct-mounted supply outlets, take-off or extension collars to supply outlets, and tap-in branch-off connections. Adjust supply outlets to provide air volume and distribution as indicated or required for tab support.

3.1.1.4 Fire Dampers

Install in accordance with manufacturer's instructions for condition of UL 555 and NFPA 90A. Locate as indicated and provide surface penetration sleeves in accordance with approved detail drawings.

3.1.1.5 Access Doors

Provide for automatic dampers, volume dampers, fire dampers, coils, thermostats, temperature controllers, valves, filters, electric duct coils, and other concealed apparatus requiring service and inspection in the duct

systems. Size shall be 12 x 12.

3.1.1.6 Duct Sleeves, Prepared Openings, and Closure Collars

Provide for ductwork penetrations in floors, walls, and partitions through which metallic ductwork passes.

a. Duct Sleeves: Fill space between duct and sleeve or between insulation and sleeve for insulated ducts with mineral fiber/firestopping, except at grilles, registers, and diffusers.

b. Prepared Openings: Fill space between duct and opening or between insulation and opening for insulated ducts with mineral fiber/fiberstopping, except at grilles, registers, and diffusers.

c. Closure Collars: Fit collars snugly around ducts or insulation. Grind edges of collar smooth to preclude tearing or puncturing insulation covering or vapor barrier. Provide nails with maximum 6 inch centers on collars.

3.1.1.7 Packing

Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber.

3.1.2 Duct Hangers and Supports

SMACNA HVAC Duct Const Stds, Section 4. Provide seismic restraint complying with SMACNA Seismic Restraint Mnl. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchors from puncturing the metal decking. Where supports are required between structural framing member, provide suitable intermediate metal framing. Provide retainer clips where C clamps are used.

3.1.2.1 Flexible Ducts

Support ducts by hangers every 3 feet, unless supported by ceiling construction. Stretch flexible air ducts to smooth out corrugations and long radius elbows. Provide minimum length to make connections.

3.1.2.2 Flexible Connectors

Provide flexible connectors between fans and ducts or casings and where ducts are of dissimilar metals or as indicated. For round ducts, securely fasten flexible connectors by zinc-coated steel clinch-type draw-bands. For rectangular ducts, lock flexible connectors to metal collars.

3.1.3 Inspection Plates and Test Holes

Provide, where required, in ductwork or casings for all balance measurements. If possible, test holes should be located at least 7.5 times diameters downstream from a disturbance. Extend cap through insulation.

3.1.4 Cleaning of Ducts

Remove all debris and dirt from ducts and wipe clean. Before installing air outlets, force air through entire system at maximum attainable velocity to remove accumulated dust. Provide temporary air filters to protect

ductwork which may be harmed by excessive dirt. For large systems, clean duct with high power vacuum machines.

3.2 FIELD QUALITY CONTROL

Administer and direct tests. Furnish instruments, equipment, connecting devices, and personnel for the tests. Notify Owner's Representative 14 days before inspection or testing is scheduled. Correct defects in work. Repeat tests until work is in compliance.

3.2.1 Duct Air Leakage Testing

Requirements for duct air leakage testing is indicated and specified in Section 15950 HVAC TESTING/ADJUSTING/BALANCING.

-- End of Section --

SECTION 15900

AUTOMATIC TEMPERATURE CONTROLS

PART 1 GENERAL

The BAS/ATC (building automation system/ automatic temperature control) systems as specified herein shall be provided in their entirety by the BAS/ATC Contractor. The BAS/ATC Contractor shall base his Bid on the system as specified, the sequence of operations, and contract documents. Regardless of the points listed in these documents, the Contractor shall provide the number of points, the types of points, and other controls as required for the sequence of operations and to provide a turn key operation.

1.1 SCOPE

It shall be the responsibility of the BAS/ATC Contractor to fully coordinate with all equipment suppliers, and with the fire alarm system designer/installer to provide a complete functional control system.

All Direct Digital Controllers shall be factory mounted, programmed and commissioned. Where factory mounting, programming or commissioning is not possible, it shall be the responsibility of BAS/ATC Contractor to provide, at time of submittal, a detailed Commissioning Plan. It shall be the responsibility of the Mechanical Equipment Supplier and the ATC Contractor to ensure that the entire system (Mechanical Equipment and Automatic Temperature Controls) be free of defects and function as specified. Any control devices required by the "Mechanical Equipment" specification or the "Automatic Temperature Control" specification shall be furnished without any additional cost to owner.

1.2 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittal Procedures."

SD-03 Product Data

Complete sequence of operation

Provide detailed commissioning procedure

Control system CAD generated drawings including all pertinent data to provide a functional operating system

Damper schedules showing size, configuration, etc.

Data sheets for all hardware and software control components

A description of the installation materials including conduit, wire, flex, etc.

SD-08 Manufacturer's Instructions

Provide as part of the submittal eight copies of all data and control drawings.

1.3 QUALIFICATIONS

The BAS/ATC Contractor shall be the local office of a nationally recognized organization within a 30-mile radius of the job site. This office shall be staffed with three (3) factory trained engineers and three (3) factory trained service technicians fully capable of providing instruction, routine maintenance and 24 hour emergency maintenance service on all system components. The ATC Contractor shall have a five year experience record in the design and installation of computerized building systems similar in scope and performance to that specified herein, and shall provide evidence of this history as condition of acceptance within 30 days after award of bid for review

PART 2 PRODUCTS

2.1 MATERIALS

All materials and equipment used will be standard components, of regular manufacture for this application. All systems and components will have been thoroughly tested and proven in actual use. Provide controls from any of the Heatpump manufactures or from one of the following:

1. Johnson Control, Inc.
2. Trane
3. Honeywell

No other manufactures or bidders will be considered.

2.2 UNIT CONTROL MODULES (UCMs)

a. Unit Control Modules (UCMs) shall be stand-alone, microprocessor based Direct Digital Controllers with sufficient memory to handle its operating system, database and programming requirements. Provide full English display for all AHU's. In lieu of display, provide a programming tool permanently mounted at each UCM location

b. The UCM's shall be pre-programmed, tested and factory mounted on the mechanical equipment to ensure reliability. Under no circumstance shall more than one UCM be utilized to control any specific piece of mechanical equipment.

1. Where factory mounting is not possible, the controllers will be factory programmed and tested prior to shipment to the job site. The controllers will be clearly labeled as to controller type, where it is to be installed, and software addresses (if applicable). The controller will be fully tested upon installation to ensure that it is properly matched to the equipment it is controlling.

c. The controller shall communicate with other devices on the communication network and be fully integrated with the other system components.

d. The hardware shall be suitable for the anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient shall be mounted within waterproof enclosures, and shall be rated for operation at

-40F to 155F.

2. Controller used in conditioned ambient shall be mounted in dust-proof enclosures, and shall be rated for operation at 32F to 120F.

2.3 INPUT/OUTPUT INTERFACE

a. Hardwired inputs and outputs may tie into the system through Building Control Unit (BCU), or Unit Control Module (UCM). Slave devices are also acceptable. Any critical points requiring immediate reaction shall be tied directly into the controller hosting the control software algorithm for the critical function.

b. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of 12mA at 12VDC to be compatible with commonly available control devices

c. All status points shown on the point list shall be positive proof differential pressure or current sensing binary switches.

d. Analog inputs shall allow the monitoring of low voltage, current, or resistance signals and shall have a minimum resolution of 0.1% of the sensing range. Analog inputs shall be compatible with, and field configurable to commonly available sensing devices.

e. Binary outputs shall provide a continuous low voltage signal for on/off control of remote devices

f. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 VDC or a 4 to 20 milliampere signal as required to provide proper control of the output device.

2.4 DAMPERS

a. The Building Automation System supplier shall provide all automatic control dampers not specified to be supplied integral to the HVAC equipment

b. Dampers shall be low leakage or high velocity low leakage as specified in the sequence of operations. All proportional dampers shall be opposed blade type. Two position dampers may be opposed or parallel blade type.

c. Damper frames and blades shall be galvanized steel and a minimum of 16 gauge. Blade width shall not exceed 8 inches. Dampers and seals shall be suitable for temperature ranges of ?50 to 250 degrees F.

d. Standard Low Leakage Dampers shall be provided to conserve energy. Dampers shall be equipped with neoprene edge seals and compressible metal jamb seals. Leakage shall not exceed 10 CFM/Sq. Ft. at 4" W.G. differential.

2.5 DAMPER OPERATORS

Damper operators shall be electronic, spring return, low voltage (24VAC) and shall be properly sized so as to stroke the damper smoothly and efficiently throughout its range. Actuator response shall be linear in response to sensed load.

2.6 TEMPERATURE SENSORS

a. Temperature sensors shall be Resistance Temperature Detector (RTD) or Thermistor as dictated by the requirements of this specification.

b. All temperature sensors shall have two integral pushbuttons which shall override and cancel the space from unoccupied to occupied. In lieu of cancel button, furnish LED which shall illuminate whenever the system is overridden

c. Duct sensors shall be rigid or averaging as specified in the sequence of operations. Averaging sensors shall be a minimum of 5 feet in length

d. Accuracy's shall be +/- 1 degree F for standard applications. Where high accuracy is required, accuracy's shall be +/- 0.2 degrees F.

2.7 DIFFERENTIAL PRESSURE SWITCHES

Differential Pressure Switches shall be furnished as indicated for status purposes in air and water applications. Provide single pole double throw switch with fully adjustable differential pressure settings

2.8 CURRENT SENSING SWITCH

A. Sensor supply voltage and supply current shall be induced from monitored conductor. Contact rating shall be 0.2 amperes at 30 volts DC/AC. Trip setpoint shall be adjustable to +/-1% of range. Current sensing switch wiring shall not be polarity sensitive

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

All electrical work performed in the installation of the BAS/ATC system as described in this specification shall be per the National Electrical Code (NEC) and per applicable state and local codes. Where exposed, conduit shall be run parallel to building lines properly supported and sized at a maximum of 40% fill. In no cases shall field installed conduit smaller than 1/2" trade size be allowed.

3.2 INSTALLATION OF SENSORS

a. Install sensors in accordance with the manufacturer's recommendations.

b. Mount sensors rigidly and adequate for the environment within which the sensor operates.

c. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.

d. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.

e. Install duct static pressure tap with tube and facing directly down-stream of airflow.

f. Sensors used in mixing pelenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine

manner horizontally across duct. Each bend shall be supported with a capillary clip.

g. All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.

h. Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.

i. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

3.3 OWNER TRAINING

a. The BAS/ATC contractor shall provide 3 copies of an operator's manual describing all operating and routine maintnance service procedures to be used with the temperature control and Building Automation System supplied. This contractor shall instruct the owner's designated representatives in these procedures during the startup and test period. The duration of the instruction period shall be no less than four-4 sessions during normal working hours.

3.4 ACCEPTANCE PROCEDURE

Upon completion of commissioning, the contractor shall submit Operation and Maintenance Manuals including, but not limited to, as-built control drawings, all software routines and all test results of the Commissioning Procedure. Before final acceptance, the BAS/ATC Contractor shall mount a detailed Automatic Temperature Control Wiring Diagram on each individual piece of HVAC equipment.

3.5 WARRANTY

All BAS/ATC devices and installation shall be warranted to be free from defects in workmanship and material for a period of one year from the date of job substantial completion. Any equipment, software, or labor found to be defective during this period shall be repaired or replaced without expense to the Owner. Factory authorized warranty service shall be available within 30 miles of jobsite. Provide four 4-hour sessions during the warranty period for program modifications desired by owner or additional training.

3.6 SEQUENCE OF OPERATION

Refer to the drawings for sequence's.

-- End of Section --

SECTION 15910

DIRECT DIGITAL CONTROL SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL(AMCA)

AMCA 500-D	(1998) Laboratory Methods of Testing Dampers for Rating

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.10	(1997) Watthour Meters
ANSI C57.13	(1993) IEEE Standard Requirements for Instrument Transformers

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE Gdln3	(1996) Reducing Emission of Halogenated Refrigerants in Refrigeration and Air-Conditioning Equipment and Systems

ASME INTERNATIONAL (ASME)

ASME B16.5	(2003) Pipe Flanges and Flanged Fittings
ASME B31.1	(2004) Power Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPVC SEC VIII	(2001) Boiler and Pressure Vessel Codes: Section VIII Rules for Construction of Pressure Vessels, Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A 126	(2004) Gray Iron Castings for Valves, Flanges, and Pipe Fittings

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE C62.45	(2002) Surge Testing for Equipment Connected to Low-Voltage (1000v and less)AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
NFPA 90A	(2002) Installation of Air Conditioning and Ventilating Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA HVAC Duct Const Stds	(1995, 2nd Ed) HVAC Duct Construction Standards - Metal and Flexible
SMACNA HVACTAB	(2002, 3rd Ed) HVAC Systems - Testing, Adjusting and Balancing

UNDERWRITERS LABORATORIES (UL)

UL 1449	(1996; Rev thru Jul 2002) Transient Voltage Surge Suppressors
UL 506	(2000; Rev thru Feb 2004) Specialty Transformers
UL 916	(1998; Rev thru Feb 2004) Energy Management Equipment

1.2 RELATED REQUIREMENTS

Section 15050 BASIC MECHANICAL MATERIALS AND METHODS, applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 Digital Controller

A control module which is microprocessor based, programmable by the user, has integral input/output within the module or on network connected modules, and performs stand-alone operations.

1.3.2 Direct Digital Control (DDC)

Digital controls, as defined in this specification, performing control logic. The controller directly senses building environment and makes control decisions based on user defined, controller resident programs. The controller outputs control signals that directly operate valves, dampers, and motor controllers. No conventional control devices, pneumatic or electronic, such as receiver-controllers, thermostats, and logic units are present within or interface with a direct digital control loop. Actuators are electric or pneumatic, and the controller output is converted to the appropriate type of signal.

1.3.3 DDC System

A system made up of one or more digital controllers which communicate on a network.

1.3.4 Distributed Control

The intent of distributed control is to install the controllers near their respective controlled equipment. The control system consists of stand-alone controllers, with the total number of input and output points limited to 48 or less per controller. Failure of any single controller will not cause the loss of more then 48 control points.

1.3.5 Dynamic Control

A process that optimizes energy efficiency of HVAC systems (air handling units, converters, pumps and boilers) by increasing and decreasing setpoints or starting and stopping equipment in response to heating and cooling needs of the facility. A requirement of dynamic control is knowing the heating/cooling demand status of the process. Therefore dynamic control requires controllers connected in a communications network.

1.3.6 Firmware

Firmware is software programmed into read only memory (ROM) and erasable programmable read only memory (EPROM) chips. Software may not be changed without physically altering the chip.

1.3.7 Hand-Held Terminal

A hand-held terminal is a manufacturer specific device connected directly to a communications port on a controller, through which the controller is accessed and, in some cases, programmed.

1.3.8 Input/Output (I/O) Points

I/O points refer to analog inputs (AI), digital inputs (DI), analog outputs (AO), and digital outputs (DO) in a digital controller. Another term for digital inputs and outputs is binary inputs and outputs. Inputs are from analog sensors (temperature, pressure, humidity, flow) and digital sensors (motor status, flow switches, switch position, and pulse output devices). Outputs operate modulating and on/off control devices.

1.3.9 I/O Expansion Unit

An I/O expansion unit provides additional point capacity to a digital controller and communicates with the stand-alone digital controller on a LAN. An I/O unit is not stand-alone because the control program does not reside in the I/O unit. An I/O expander which connects directly to a stand alone controller through a multi-line microprocessor bus is restricted to reside within 3 feet of the stand alone controller and is considered part of the stand alone controller.

1.3.10 Local Area Network (LAN)

a. A communications bus that interconnects digital controllers for peer-to-peer (see "peer-to-peer" below) communications. Different levels of LANs are possible within a single DDC system. In this case, a digital controller on a higher level LAN acts as a network controller to the controllers on the lower level LAN. The network controller, then, has at least two LAN communications ports. One port supports peer-to-peer communications with other digital controllers on the higher level LAN. The other port supports communications with the digital controllers on the lower

level LAN.

b. LANs permit sharing global information. This allows building and site wide control strategies such as peak demand limiting, dynamic control strategies, coordinated response to alarm conditions, and remote monitoring and programming of digital controllers.

1.3.11 Microprocessor

A microprocessor refers to the central processing unit (CPU) that contains all registers and logic circuitry that allow digital controllers to function.

1.3.12 Output Signal Conversion

Output signal conversion refers to changing one kind of control output into a proportionally related signal appropriate for direct actuation of the controlled device. An example is converting a 4 to 20 mA or 0 to 10 VDC signal to a proportional 3 to 15 psig signal to operate a pneumatic actuator.

1.3.13 Optimum Start

Optimum start is a method of starting HVAC equipment prior to scheduled occupancy in order to have the building at setpoint when occupied. Optimum start is based on the zone temperatures, zone setpoints, and outdoor temperature.

1.3.14 Peer-to-Peer

Peer-to-peer refers to controllers connected on a communications LAN that act independently, as equals, and communicate with each other to pass information.

1.3.15 PID

PID refers to proportional, integral, and derivative control; the three types of action that are used in controlling modulating equipment.

1.3.16 Resolution

Refers to the number of possible states an input value or output value can take and is a function of the digital controller I/O circuitry; the A/D converter for input and the D/A converter for output. Ten bit resolution has 1024 possible states.

1.3.17 Stand-Alone Control

Refers to the digital controller performing required climate control, and energy management functions without connection to another digital controller or computer. Requirements for stand-alone control are a time clock, a microprocessor, resident control programs, PID control, and I/O. All stand-alone controllers have a communication port and firmware for direct connection and interrogation with a laptop computer or similar hand-held device. This interrogation includes parameter changes and program downloads.

1.3.18 Terminal Control Unit (TCU)

An off-the-shelf, stand-alone digital controller equipped for communication on a lower level LAN. TCUs may deviate from stand-alone only in receiving energy management and time information from a stand alone digital controller. A TCU is commonly application specific and is used for distributed control of specific HVAC subsystems. A TCU communicates with other digital controllers. Typically, a TCU communicates on a lower level LAN. Examples where TCUs are used include small air handling units (AHUs), variable air volume (VAV) boxes, fan coil units, and heat pumps.

1.4 DDC SYSTEM DESCRIPTION

a. Provide new DDC systems including associated equipment and accessories. Manufacturer's products, including design, materials, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.1 and NFPA 70, except as modified herein or indicated otherwise.

b. Provide the DDC systems to maintain stable temperature control and all other conditions as indicated. The end-to-end accuracy of the system, including temperature sensor error, wiring error, A/D conversion, and display, shall be 1 degree F or less.

1.4.1 Design Requirements

1.4.1.1 Control System Schematic

Provide control system schematic that includes the following:

a. Location of each input and output device

b. Flow diagram of each HVAC component, for instance flow through coils, fans, dampers

c. Name or symbol for each component such as V-1, DM-2, and T-1 for a valve, damper motor, and temperature sensor, respectively

d. Setpoints

e. Sensor range

f. Actuator range

g. Valve and damper schedules and normal position

h. Switch points on input switches

i. Written sequence of operation for each schematic

j. Schedule identifying each sensor and controlled device with the following information:

(1) LAN and Software point name with send and receive address if applicable

(2) Point type (AO, AI, DO, DI)

(3) Point range

(4) Digital controller number for each point

1.4.1.2 Electrical Equipment Ladder Diagrams

Submit diagrams showing electrical equipment interlocks, including voltages and currents.

1.4.1.3 Component Wiring Diagrams

Submit a wiring diagram for each type of input device and each type of output device. Diagram shall show how the device is wired and powered; showing typical connections at the digital controller and each power supply, as well as at the device itself. Show for all field connected devices, including, but not limited to, control relays, motor starters, electric or electronic actuators, and temperature, pressure, flow, proof, and humidity sensors and transmitters.

1.4.1.4 Terminal Strip Diagrams

Submit a diagram of each terminal strip, including digital controller terminal strips, terminal strip location, termination numbers and associated point names.

1.4.1.5 Communication Architecture Schematic

Submit a schematic showing communication networks used for all DDC system controllers, workstations, and field interface devices.

1.5 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Control system schematic

Ladder diagrams

Component wiring diagrams

Terminal strip diagrams

Communication architecture schematic

SD-03 Product Data

DDC hardware

DDC capabilities

VARIABLE FREQUENCY MOTOR DRIVES

Workstation software

Input devices

Output devices

Surge and Transient Protection

PC computer

Smoke detectors

SD-07 Certificates

Contractors Qualifications

Training

SD-10 Operation and Maintenance Data

Controls and HVAC System Operators Manual

DDC Manufacturer's Hardware and Software Manuals

SD-11 Closeout Submittals

Training Course Documentation

Service organizations

Contractor certification

1.6 Operating environment

Protect components from humidity and temperature variations, dust, and other contaminants, within limits published by the manufacturer.

1.7 QUALITY ASSURANCE

1.7.1 Standard Products

a. Material and equipment shall be standard products of manufacturer regularly engaged in the manufacturing of such product, using similar materials, design and workmanship. The standard products shall have been in commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of similarly sized equipment and materials used under similar circumstances and sold on the commercial market through advertisements, manufacturers' catalogs, or brochures.

b. Products are supported by a local service organization.

c. Provide a complete control system from only one of the following if not the same as the manufacturer of the Heatpumps:

1. Johnson Controls, Inc.
2. Trane
3. Honeywell

1.7.1.1 DDC Hardware

a. I/O type and characteristics

b. Resident programs

c. Communications ports

d. Protected memory

e. Operating temperature limits

1.7.1.2 DDC Capabilities

a. Communications; baud rates, communication ports, hierarchy

b. Trending capabilities

c. Alarming capabilities; capable of alarm generation as defined in this specification

d. Messaging capabilities

e. Self diagnostic capabilities

e. PID control capabilities

1.7.1.3 Workstation Software

a. Mouse and keyboard operation

b. Communications

c. DDC Program download capability

d. Dynamic point update

e. Program modification

f. Database modification

g. Graphics and graphics modification

h. Penetration of graphics

1.7.1.4 Input Devices

a. Transmitters

b. Temperature sensors

c. Humidity sensors

d. Pressure sensors

e. Flow or motor proof

f. Sensor wells

1.7.1.5 Output Devices

a. Dampers

b. Valves

c. Actuators

d. Control relays

e. Solenoid air valves

f. Electronic to pneumatic transducer

1.7.1.6 Surge and Transient Protection

a. Power line

b. Communications lines

c. Controller I/O

1.7.2 Nameplates and Tags

a. Nameplates and tags bearing device unique identifiers shall be engraved or stamped. Permanently attach nameplates to HVAC control panel doors and back plates.

b. For each field mounted piece of equipment attach a plastic or metal tag with equipment name and point identifier.

1.7.3 Verification of Dimensions

The contractor shall verify all dimensions in the field, and shall advise the Owner's Representative firm of any discrepancy before performing work.

1.7.4 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the mechanical, electrical, and finish conditions that could affect the work, and shall furnish all work necessary to meet such conditions.

1.7.4.1 List of Drawings

Provide a list of drawings.

1.7.4.2 List of Symbols and Abbreviations Used on Drawings

Provide an index of symbols and abbreviations used on the drawings.

1.7.4.3 List of I/O Points

For each input and output physically connected to a digital controller provide the following:

a. Point description: for example: mixed air temperature, supply fan start/stop, etc.

b. Point type: AO, AI, DO, or DI.

c. Point range

d. Sensor range associated with point range:

e. Software name(s) associated with point, if any.

f. Point connection terminal number

1.7.4.4 Equipment Components List

Submit a listing of controllers and connected devices shown on control system schematic. List the following:

a. Control system schematic name

b. Description

c. Manufacturer of controller

d. Controller's name

e. Equipment part numbers

f. Cv for valves

g. For actuators:

(1) Motive force (such as pneumatic, or electric)

(2) Normal position

(3) Nominal operating range (such as 3 to 7 psi, 4 to 8 mA)

1.7.4.5 AC Power Table

Submit a table listing each controller and the circuit breaker number, panel box number, and physical location of each controller's source of AC power.

1.7.5 Contractors Qualifications

a. The Contractor or subcontractor performing the work shall have completed at least three DDC systems installations of a similar design and have successfully operated a similar sequence of operation for at least three years.

1.7.6 Pressure Tank Certification

Provide certification stating pressure tanks are constructed and labeled in accordance with ASME BPVC SEC VIII for a minimum of 125 psig working pressure.

1.7.7 Training Course Documentation

Training course documentation including a manual for each trainee plus two additional copies and one copy of audiovisual training aids, if used. Documentation shall include an agenda, defined objectives for each lesson and detailed description of the subject matter of each lesson.

1.7.8 Service Organizations

Qualified service organization list including the names and telephone numbers of organizations qualified to service the HVAC control systems.

1.7.9 Contractor Certification

Provide certification that installation of the control system is complete and meets the technical requirements of this section.

1.7.10 Controls and HVAC System Operators Manual

Provide two copies of a Control and HVAC Systems Operators Manual. Provide in a 3 ring binder with a minimum of the following 7 sections. Use tabs to divide each section.

a. Description of HVAC Systems: Provide a description of the HVAC system components and control system. Include sequence of operation and a complete points list.

b. Controls Drawings: Provide drawings as specified in submittal paragraph.

c. Control Program Listings: Provide listing of all control programs, including terminal equipment controller setup pages if used.

d. Current Operating Parameters: Provide printouts of input and output setup information, (database setups). This section provides information such as point addresses, slopes and offsets for all points, database of points, etc.

e. Design Information: Include relevant design data and calculations.

f. Control Equipment Technical Data Sheets: Provide technical data sheets for all controller hardware and accessories.

g. Backup of Control Program: Provide backup copies of the control program and ACAD control drawings on CD-ROM.

1.7.11 DDC Manufacturer's Hardware and Software Manuals

Provide the following manuals.

a. Installation and Technical Manuals for all digital controller hardware.

b. Operator Manuals for all digital controllers.

c. Operator Manuals for all workstation software.

d. Programming Manuals for all digital controllers.

e. Programming Manuals for workstation software.

1.7.12 Modification of References

The advisory provision in ASME B31.1 and NFPA 70 are mandatory. Substitute the word "shall" for "should" wherever it appears and interpret all

references to the "authority having jurisdiction" and "owner" to mean the Owner's Representative firm.

PART 2 PRODUCTS

2.1 DDC SYSTEM

a. Provide a Web based DDC system with color graphic display as a distributed control system. The system shall have stand-alone digital controllers, a communications Network, and a separate workstation computer with workstation software.

b. Provide an operator programmable system to perform closed-loop, modulating control of building equipment. Connect all digital controllers through the communication network to share common data and report to workstation computers. Provide workstation DDC software capable of programming and monitoring the digital controllers. The control system shall be capable of downloading programs between the workstation and digital controllers.

c. Provide the quantity of digital controllers need to perform as indicated on the drawings and to perform required climate control, energy management, and alarm functions. The quantity of controllers shall be no less than the number shown on drawings. All material used shall be currently in production.

2.1.1 Direct Digital Controllers

DDC hardware shall be UL 916 rated.

2.1.1.1 Distributed Control

Apply digital controllers in a distributed control manner.

2.1.1.2 I/O Point Limitation

Total number of I/O hardware points, including those communicated over a LAN, used by a single stand-alone digital controller, including I/O expansion units shall not exceed 48.

2.1.1.3 Environmental Operating Limits

Provide digital controllers that operate in environmental conditions between 32 and 120 degrees F.

2.1.1.4 Stand-Alone Control

Provide stand-alone digital controllers (with future Net/Web access).

2.1.1.5 Internal Clock

Provide a clock with each stand-alone controller. Each controller shall have its clock backed up by a battery or capacitor with sufficient capacity to maintain clock operation for a minimum of 72 hours during power outage.

2.1.1.6 Memory

a. Provide sufficient memory for each controller to support required control, communication, trends, alarms, and messages

b. Memory Protection: Programs residing in memory shall be protected either by using EEPROM, flash memory, or by an uninterruptible power source (battery or uninterruptible power supply (UPS)). The backup power source shall have sufficient capacity to maintain volatile memory during an AC power failure. Where the uninterruptible power source is rechargeable (a rechargeable battery), provide sufficient back-up capacity for a minimum of seventy-two hours. The rechargeable power source shall be constantly charged while the controller is operating under normal line power. Where a non-rechargeable power source is used, provide sufficient capacity for a minimum of two years accumulated power failure. Batteries shall be replaceable without soldering.

2.1.1.7 Inputs

Provide input function integral to the direct digital controller. Provide input type(s) as required by the DDC design. For each type of input used on high-level controllers, provide at least one similar spare input point per controller.

a. Analog Inputs: Allowable input types are 100 ohm (or higher) platinum RTDs, thermistors, 4 to 20 mA, and 0-10 VDC. Thermistor and direct RTD inputs must have appropriate conversion curves stored in controller software or firmware. Analog to digital (A/D) conversion shall have 10-bit minimum resolution.

b. Digital Inputs: Digital inputs shall sense open/close, on/off, or other two state indications.

2.1.1.8 Outputs

Provide output function integral to the direct digital controller. Provide output type(s) as required by the DDC design. For each type of output used on high-level controllers, provide at least one similar spare output point per controller.

a. Analog Outputs: Provide controllers with 10 bit minimum output resolution. Output shall be 4 to 20 mA, 0 to 10 VDC, or 0 to 20 psig. Each pneumatic output shall have feedback for monitoring of the actual pneumatic signal.

b. Digital Outputs: Provide contacts rated at a minimum of 1 ampere at 24 volts.

2.1.1.9 PID Control

Provide controllers with proportional integral, and derivative control capability. Terminal controllers (TCV) are not required to have the derivative component.

2.1.1.10 Digital Controller Networking Capabilities

The upper level digital controllers shall be capable of networking with other similar upper level controllers. Upper level controllers shall also be capable of communicating over a network between buildings.

2.1.1.11 Communications Ports

a. Controller-to-Controller LAN Communications Ports: Controllers in the building DDC system shall be connected in a communications network. Controllers shall have controller to controller communication ports to both peer controllers (upper level controllers) and terminal controllers (lower level controllers). Network may consist of more than one level of local area network and one level may have multiple drops. Communications network shall permit sharing information between controllers, allowing execution of dynamic control strategies, and coordinated response to alarm conditions. Minimum baud rate for the lowest level LAN is 9600 Baud. Minimum baud rate for the highest level LAN shall be 9600 Baud. Minimum baud rate for a DDC system consisting of a single LAN is 9600 Baud.

b. On-Site Interface Ports: Provide a RS-232, RS-485, or RJ-11 communications port for each digital controller that allows direct connection of a computer or hand held terminal and through which the controller may be fully accessed. Controller access shall not be limited to access through another controller. On-site interface communication ports shall be in addition to the communications port(s) supporting controller to controller communications. Communication rate is 9600 Baud minimum. Every controller on the highest level LAN shall have a communications port supporting direct connection of a computer; a hand held terminal port is not sufficient. By connecting a computer to this port, every controller in the direct digital control system shall be accessible and programmable.. The following operations shall be available: downloading and uploading control programs, modifying programs and program data base, and retrieving or accepting trend reports, status reports, messages, and alarms.

c. Remote Work Station Interface Port: Provide one additional direct connect computer port in each DDC system for permanent connection of a remote operator's work station, unless the workstation is a node on the LAN. All operations possible by directly connecting a computer to a controller at the highest level LAN shall be available through this port.

d. Telecommunications Interface Port: Provide one additional telecommunications port in each DDC system permitting remote communications via telephone. All operations possible by directly connecting a computer to a controller at the highest level LAN shall be available through the telecommunications port. A telecommunications port provided on a digital controller shall be in addition to the port required for directly connecting a computer to the controller. Telecommunication baud rate is 28000 minimum.

2.1.1.12 Modem

Provide two modems per DDC system to communicate between the digital control system and the computer workstation. Minimum modem baud rate is 56 Kbaud with v.90 communication standard. Locate modem at operators work station.

2.1.1.13 Digital Controller Cabinet

Each indoor digital controller cabinet shall protect the controller from dust and rated NEMA 1, unless specified otherwise. Each outdoor digital controller cabinet shall protect the controller from all outside conditions and rated NEMA 4. Cabinets for high level controllers shall be hinged door, lockable, and have offset removable metal back plate.

2.1.1.14 Main Power Switch

Each controller on the highest level LAN or each control cabinet shall have a main external power switch for isolation of the controller from AC power. The switch shall be located in the DDC cabinet.

2.1.2 Terminal Control Units

a. The same company as the digital controllers shall manufacture TCUs.

b. TCUs shall automatically start-up on return of power after a failure, and previous operating parameters shall exist or shall be automatically downloaded from a digital controller on a higher level LAN.

c. TCUs do not require an internal clock if they get time information from a higher level digital controller.

2.1.3 DDC Software

This system is Web based and must be Windows based.

2.1.3.1 Sequence of Control

Provide, in the digital controllers, software to execute the sequence of control. Provide one registered copy of all software used to program control sequences in all direct digital controllers and LAN controllers on the computer workstation. Provide any access keys which restrict programming language software functions or the ability to compile or prepare programming for download to controllers. Provide final copy of each program used in the system in both compiled and editable formats. Where specially programmed factory configured smart controllers are used in the system, provide minimum factory programming tools and specialized controller programs ready for download to replacement controllers. At minimum, controllers must be capable of performing programming functions outlined in the following "Parameter Modification" section.

2.1.3.2 Parameter Modification

Provide software to modify control parameters. Parameter modification for all controllers (high level and low level application specific) is through the main workstation computer. Modifications accomplished without having to make changes directly in line-by-line programming. When the control program is of the line-by-line type, database parameters in the following list that take real number values require assignment of variable names so parameters can be changed without modifying programming. Alternatively, block programming languages shall provide for modification of these database parameters in fill-in-the-blank screens. Parameters of like type, including those in different high level and low level controllers, may be grouped together for a single, global change. For example, an operator may

group all second floor space temperature setpoints into a group and raise the setpoint by two degrees with a single command. The following parameters shall be modifiable in this way:

a. Setpoints

b. Dead band limits and spans

c. Reset schedules

d. Switch over points

e. PID gains and time between control output changes

f. Time

g. Timed local override time

h. Occupancy schedules

i. Holidays

j. Alarm points, alarm limits, and alarm messages

k. Point definition database

l. Point enable, disable, and override

m. Trend points, trend intervals, trend reports

n. Analog input default values

o. Passwords

p. Communications parameters including network and telephone communications setups

2.1.3.3 Differential

Where setpoint is in response to some analog input such as temperature, pressure, or humidity, include a setpoint differential to prevent short cycling of control devices.

2.1.3.4 Motor and Flow Status Delay

Provide an adjustable delay between when a motor is commanded on or off and when the control program looks to the motor or flow status input for confirmation of successful command execution.

2.1.3.5 Run time Accumulation

Provide resettable run time accumulation for each controlled digital output.

2.1.3.6 Timed Local Override

Provide user definable adjustable run time for each push of a momentary contact timed local override. Pushes shall be cumulative with each push designating the same length of time. Provide a user definable limit on the

number of contact closures summed, such as 6, before the contact closures are ignored. Timed local overrides are disabled during occupancy periods.

2.1.3.7 Time Programs

Provide programs to automatically adjust for leap years, daylight savings time, and operator time adjustments.

2.1.3.8 Scheduling

a. Individual controlled equipment shall be schedulable with schedule based on time of day, day of week, and day of year. Equipment may be associated into groups. Each group may be associated with a different schedule. Changing the schedule of a group shall change the schedule of all equipment in the group. Groups may be modified, created and deleted by the operator.

b. Provide capability to view and modify schedules in a seven-day week format. When control program does not automatically compute holidays, provide capability to enter holiday schedules one full year at a time.

2.1.3.9 Point Override

I/O and virtual points shall accept software overrides to any possible value.

2.1.3.10 Alarming

I/O points and software points shall be alarmable. Alarms may be enabled and disabled for every point. Alarm limits shall be adjustable on analog points. Controllers connected to an external communications device such as a printer, terminal, or computer, shall download alarm and alarm message when alarm occurs. When a computer workstation is connected to a DDC system with a LAN or modem, operator selected alarm conditions will initiate a call and report to the computer or an alphanumeric pager. Otherwise alarms will be stored and automatically downloaded when a communications link occurs. The following conditions shall generate alarms:

a. Motor is commanded on or off but motor status input indicates no change

b. Temperature, humidity, or pressure strays outside selectable limits

c. An analog input takes a value indicating sensor failure

d. A module is not communicating on the LAN

e. A power outage occurs

2.1.3.11 Messages

Messages shall be operator defined and assigned to alarm or status conditions. Messages shall be displayed on the workstation or printer when these conditions occur.

2.1.3.12 Trending

DDC system shall have the capability to trend all I/O and virtual points.

Points may be associated into groups. A trend report may be set up for each group. The period between logging consecutive trend values shall range from one minute to 60 minutes at a minimum The minimum number of consecutive trend values stored at one time shall be 30 per variable. When trend memory is full, the most recent data shall overwrite the oldest data. Trend data shall be capable of being uploaded to computer. Trend data shall be available on a real time basis; trend data shall appear numerically and graphically on a connected computer's screen as the data is processed from the DDC system. Trend reports shall be capable of uploading to computer for storage.

2.1.3.13 Status Display

Current status of I/O and virtual points shall be displayed on command. Points shall be associated into functional groups, such as all the I/O and virtual points associated with control of a single air handling unit, and displayed as a group, so the status of a single mechanical system can be readily checked. A group shall be selectable from a menu of groups having meaningful names; such as AHU-4, Second Floor, Chiller System, and other such names.

2.1.3.14 Diagnostics

Each controller shall perform self-diagnostic routines and provide messages to an operator when errors are detected. The DDC system shall be capable of recognizing a non-responsive module on a LAN. The remaining, responsive modules on a LAN shall not operate in a degraded mode.

2.1.3.15 Power Loss

During a power outage, each controller shall assume a disabled status and outputs shall go to a user definable state. Upon restoration of power, DDC system shall perform an orderly restart, with sequencing of outputs.

2.1.3.16 Program Transfer

Provide software for download of control programs and database from a computer to controllers and upload of same to computer from controllers. Every digital controller in the DDC system shall be capable of being downloaded and uploaded to through a single controller on the highest level LAN.

2.1.3.17 Password Protection

Provide at least three levels of password protection to the DDC system permitting different levels of access to the system. The lowest level allows monitoring only. The highest level allows full control of all functions, including setting new passwords.

2.1.3.18 Energy Data Recording

Provide a resettable signal accumulation for each meter at the main building digital controller.

a. Calculate Geo thermal energy in BTU/HR using water supply temperature and flow and hot water return temperature signals.

b. Record recycled water flows in GPM using flow meters.

c. Record electrical energy in BTU/HR. and electrical demand in BTU.

2.1.4 Workstation

a. Provide a central workstation computer with installed software to provide an interface for monitoring, troubleshooting, and making adjustments to the program or operating parameters of all DDC controllers, including TCUs. The workstation shall also be capable of programming all controllers, including TCUs.

b. DDC system shall routinely operate continuously without connection to the workstation. Information at the workstation is not required for day to day operations of the direct digital controllers.

2.1.4.1 Hardware

The DDC system manufacturer shall recommend all workstation computer equipment and peripherals. The workstation shall be configured to operate according to the DDC system manufacturer's specifications. Workstation hardware shall be configured to allow operation of software, uploading and downloading of programs, and creation of graphics. At a minimum the workstation hardware shall consist of:

a. Computer; computer shall use Microsoft Windows XP, 2000, or NT, and shall not have less than Intel Pentium 4 processor, running at 2.0 megahertz speed, 40 giga-byte hard disc, 256 megabyte RAM, 1 serial and 1 parallel port, 2 USB ports, 17 inch LCD flat panel monitor with 740 x 1024 and 0.28 dpi minimum resolution, 101 character keyboard, a 1.4 megabyte 3 1/2 inch floppy drive, 48X internal CD/writer ROM drive.

b. Mouse

c. Modem; 56 Kbaud, v.90 standard

d. Printer; printer shall be laser output with one spare cartridge.

e. 120-volt terminal strip UL 1449 6-outlet with surge protection.

2.1.4.2 Software

Workstation software shall be configured to operate according to the DDC system manufacturer's specifications. Software shall be installed in the workstation computer and permit monitoring and troubleshooting of the DDC system. Workstation software permits modification of controller parameters and control for all controllers, both high level and low level application specific. Operations shall be menu selected. Menu selections shall be made with a mouse.

a. Menu System: Menu system shall allow an operator to select a particular function or access a particular screen through successive menu penetration.

b. Controller Parameter Modification: The workstation software shall be an interface for performance specified in paragraph entitled "Parameter Modification" and available through direct connection

of a computer to a digital controller. Parameter modification shall require only that an operator "fill in the blank" for a parameter on a screen requesting the information in plain language. Parameter modifications shall download to the appropriate controllers at operator request.

c. Program modification: For systems using a line-by-line programming language, provide an off-line text editor, similar to a BASIC program editor, permitting modification of controller resident control programs. For systems using block programming languages provide a capability for linking blocks together to create new programs or modify existing programs. Program modifications shall download to appropriate controllers at operator request.

2.1.4.3 Graphic-Based Software

The workstation shall use Web based graphic-based software to provide a user-friendly interface to the DDC system. Graphic-based software shall provide graphical representation of the building, the buildings mechanical systems, and the DDC system. The current value and point name of every I/O point shall be shown on at least one graphic and in its appropriate physical location relative to building and mechanical systems.

a. Graphics shall closely follow the style of the control drawings in representing mechanical systems, sensors, controlled devices, and point names.

b. Graphic Title: Graphics shall have an identifying title visible when the graphic is viewed.

c. Dynamic Update: When the workstation is on-line with the control system, point data shall update dynamically on the graphic images.

d. Graphic Penetration: Provide graphic penetration when the capability exists. For systems without graphic penetration, provide menu penetration for selection of individual graphics to give the same hierarchical affect provided by graphic penetration.

e. Graphic Types: Graphic-based software shall have graphics of the building exterior, building section, floor plans, and mechanical systems. Provide the following graphics:

(1) Building Exterior Graphic: Show exterior architecture, major landmarks, and building number.

(2) Building Section Graphic: Show floors in section graphic with appropriate floor name on each floor.

(3) Floor Plan Graphics: Provide a single graphic for each floor, unless the graphic will contain more information than can reasonably be shown on a single graphic. Each heating or cooling zone within a floor plan shall have a zone name and its current temperature displayed within the zone outline. Show each controlled variable in the zone. Provide visual warning for each point in alarm.

(4) Mechanical System Graphics: Provide two-dimensional drawings to symbolize mechanical equipment; do not use line drawings. Show controlled or sensed mechanical equipment. Each graphic shall

consist of a single mechanical system; examples are a graphic for an air handling unit, a graphic for a VAV box, a graphic for a heating water system, and a graphic for a chiller system. Place sensors and controlled devices associated with mechanical equipment in their appropriate locations. Place point name and point value adjacent to sensor or controlled device. Provide visual warning of each point in alarm. Point values shall update dynamically on the graphic.

f. Graphic Editing: Full capacity as provided by a draw software package shall be included for operator editing of graphics. Graphics may be created, deleted, modified, and text added. Provide capability to store graphic symbols in a symbol directory and import these symbols into graphics. A minimum of 256 colors shall be available.

g. Dynamic Point Editing: Provide full editing capability for deleting, adding, and modifying dynamic points on graphics.

h. Trending: Trend data shall be displayed graphically, with control variable and process variable plotted as functions of time on the same chart. Graphic display of trend data shall be internal to the workstation software and not resulting from download of trend data into a third-party spreadsheet program such as Excel, unless such transfer is automatic and transparent to the operator, and the third-party software is included with the workstation software package. At the operator's discretion, trend data shall be plotted real time.

2.2 SENSORS AND INPUT HARDWARE

2.2.1 Field Installed Temperature Sensors

2.2.1.1 Thermistors

Precision thermistors may be used in temperature sensing applications below 200 degrees F. Sensor accuracy over the application range shall be 0.36 degree F or less between the range of 32 to 150 degrees F. Stability error of the thermistor over five years shall not exceed 0.25 degree F cumulative. Sensor element and leads shall be encapsulated. Bead thermistors are not allowed. A/D conversion resolution error shall be kept to 0.1 degree F. Total error for a thermistor circuit shall not exceed 0.5 degree F, which includes sensor error and digital controller A/D conversion resolution error. Provide 18 gage twisted and shielded cable for thermistors.

2.2.1.2 Resistance Temperature Detectors (RTDs)

Provide RTD sensors with 1000 ohm, or higher, platinum elements that are compatible with the digital controllers. Sensors shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1 percent (1 ohm) of expected ohms (1000 ohms) at 32 degrees F. Temperature sensor stability error over five years shall not exceed 0.25 degree F cumulative. Direct connection of RTDs to digital controllers, without transmitters, is preferred provided controller supports direct connection of RTDs. When RTDs are connected directly to the controller, keep lead resistance error to 0.25 degree F or less. Total error for a RTD circuit shall not exceed 0.5 degree F, which includes sensor error, lead resistance error or 4 to 20 mA or 0 to 10 VDC

transmitter error, and A/D conversion resolution error.

2.2.1.3 Temperature Sensor Details

a. Room Type: Conceal element behind protective cover matched to the room interior. Room temperature sensors connected directly to application specific controllers shall have integral pushbutton, system override digital input button, and a setpoint adjustment lever. Provide a connection to allow interrogation of the digital controller.

b. Duct Averaging Type: Continuous averaging RTDs for ductwork applications shall be one foot in length for each 4 square feet of ductwork cross-sectional area with a minimum length of 6 feet. Probe type duct sensors of one foot length minimum are acceptable in ducts 12 feet square and less.

c. Immersion Type: Three inches total immersion for use with sensor wells, unless otherwise indicated.

d. Sensor Wells: Stainless steel material. Provide heat-sensitive transfer agent between exterior sensor surface and interior well surface.

e. Outside Air Type: Provide element on the buildings north side with sunshade to minimize solar effects. Mount element at least 3 inches from building outside wall. Sunshade shall not inhibit the flow of ambient air across the sensing element. Shade shall protect sensing element from snow, ice, and rain.

2.2.2 Transmitters

Transmitters shall have 4 to 20 mA or 0 to 10 VDC output linearly scaled to the temperature, pressure, humidity, or flow range sensed. Transmitter shall be matched to the sensor, factory calibrated, and sealed. Total error shall not exceed 0.1 percent at any point across the measured span. Supply voltage shall be 24 volts AC or DC. Transmitters shall have non-interactive offset and span adjustments. For temperature sensing, transmitter stability shall not exceed 0.05 degrees C a year.

2.2.2.1 Spans and Ranges

Transmitter spans or ranges shall meet the following:

a. Temperature:

(1) 50 degrees F span: Room, Geothermal, cooling coil discharge air, return air sensors

(2) 100 degrees F span: Outside air, Geothermal water, coils discharge air, mixed air sensors

(3) 200 degrees F span: Electric heating coil water system sensors.

b. Pressure:

(1) -0.5 to 0.5 inches water differential range: static pressure control of rooms

(2) 0 to 5 inches water differential range: Duct static pressure

(3) 0 to 60 psig differential: Water differential pressure

c. Relative Humidity:

(1) 10 to 90 percent minimum relative humidity range

2.2.3 Relative Humidity Transmitters

Provide integral humidity transducer and transmitter. Output of relative humidity instrument shall be a 4 to 20 mA or 0 to 10 VDC signal proportional to full range of relative humidity input. Accuracy shall be 2 percent of full scale, long-term stability shall be less than one percent drift per year. Sensing element shall be polymer type.

2.2.4 Pressure Transmitters

Provide integral pressure transducer and transmitter. Output of pressure instrument shall be a 4 to 20 mA signal proportional to the pressure span. Accuracy shall be 1.0 percent. Linearity shall be 0.1 percent.

2.2.5 Current Transducers

Provide current transducers to monitor amperage of motors. Select current transducer for normal measured amperage to be near 50 percent of full-scale range. Current transducers shall have an accuracy of one percent and 4 to 20 mA or 0 to 10 VDC output signal.

2.2.6 Air Quality Sensors

2.2.6.1 Sensor

Provide CO2 sensors with integral transducers where shown. Output signal shall be 4 to 20 mA or 0 to 10 VDC. Accuracy shall be +/- 5 percent of full scale.

2.2.7 Input Switches

2.2.7.1 Timed Local Override

Provide momentary contact push button override with override time set in controller software. Provide to override DDC time of day program and activate occupancy program for assigned units. Upon expiration of override time, the control system shall return to time-of-day program. Time interval for the length of operation shall be software adjustable and shall expire unless reset.

2.2.7.2 Hand-Off-Auto Switch

Provide hand-off-auto switch with name plate to manually switch between off, DDC (auto) and manual (hand) control. Size and wire hand-off-auto switch to switch control (120 VAC or less), not line, circuitry. Wire all safety controls to protect circuit and equipment during both hand and auto operation.

2.2.7.3 Insertion Freeze Protection Switch

Electric switch shall be capillary type. Provide special purpose insertion thermostats with flexible elements a minimum of 20 feet in length for coil face areas up to 40 square feet. Switch contacts shall be rated for motor starter circuit voltage being interrupted. Switch shall be equipped with auxiliary set of contacts for input of switch status to digital controller. Provide additional elements or longer elements for larger coils at the rate of 1-foot of element per 4 square feet of coil. Serpentine capillaries perpendicular to the air flow to uniformly sense the entire airflow. A freezing condition at 18-inch increments along the sensing element shall activate the thermostatic switch. Switch shall require manual reset after activation.

2.2.7.4 Non-Modulating, Electric, Humidistat Switch

Provide a set point adjustable, wall mounted humidistat. Contacts shall be Single Pole Double Throw(SPDT) for low voltage (24volt) applications. Adjustable set-point range shall be 20%-80% relative humidity. Sensing element shall be bulk polymer or thin film polymer with an accuracy of plus or minus 2 percent over the entire range. Sensing element shall be non-saturating and shall be capable of withstanding a saturated condition without permanently affecting calibration or sustaining damage. Humidistat cover shall consist of locking metal or heavy-duty plastic.

2.2.8 Electronic Airflow Measurement Stations and Transmitters

a. Station - Each station shall contain an array of velocity sensing elements and straightening vanes inside a flanged sheet metal casing. The velocity sensing elements shall be of the RTD or thermistor type. The sensing elements shall be distributed across the duct cross section in the quantity and pattern set forth for measurements and instruments of ASHRAE Gdln3 and SMACNA HVACTAB for the traversing of ducted air flows. The resistance to airflow through the airflow measurement station shall not exceed 0.08 inch water gage at an airflow of 2,000 fpm. Station construction shall be suitable for operation at airflow of up to 5,000 fpm over a temperature range of 40 to 120 degrees F, and accuracy shall be plus or minus 3 percent over a range of 125 to 2,500 fpm scaled to air volume.

b. Each transmitter shall produce a linear, temperature compensated 4 to 20 mA or 0 to 10 VDC output corresponding to the actual air flow. The transmitter shall be a 2-wire, loop powered device. The output error of the transmitter shall not exceed 0.5 percent of the calibrated measurement.

2.2.9 Energy Metering

2.2.9.1 Electric Meters

Provide kilowatt-hour (kWh) meter for building as indicated. Integrate electric meter signal into DDC system; meter signal output must be compatible with DDC input. DDC shall measure both instantaneous and accumulated electrical usage.

a. Meter: ANSI C12.10. Provide watt-hour meter and socket corresponding to the ratios of the current transformers and

transformer secondary voltage. Meters shall be selected for three-phase, four-wire wye delta system, three-element type with three current transformers. Meters shall be complete with a box mounted socket having automatic circuit closing bypass. Provide watt-hour meter with not less than four pointer-type kWh registers, provisions for pulse initiation, and a universal Class 2 indicating maximum kW demand register, sweep pointer indicating type, with a 30-minute interval. Meter accuracy shall be within plus or minus one percent. The correct multiplier shall be provided on face of meter.

b. Current Transformers: ANSI C57.13. Provide three current transformers with 600-volt insulation, rated for metering with voltage, BIL, momentary, and burden ratings coordinated with the ratings of the associated meters. Provide a butyl molded donut or window type transformers mounted on a bracket to allow secondary cables to connect to the transformer bushings. Identify the wiring of the current transformer secondary feeders to permit field current measurements to be taken with hook-on ammeters.

2.3 OUTPUT HARDWARE

2.3.1 Dampers

Damper shall conform to SMACNA HVAC Duct Const Stds.

a. A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger sized damper shall be made from a combination of sections.

b. Dampers shall be steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. Blades shall be provided with compressible seals at points of contact. The channel frames of the dampers shall be provided with jamb seals to minimize air leakage. Dampers shall not leak in excess of 20 cfm per square foot at 4 inches water gage static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 degrees F to 200 degrees F. Dampers shall be rated at not less than 2000 fpm air velocity. All blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section will not be located directly in the air stream. Damper axles shall be 0.5 inch (minimum) plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not exceed 0.04 inch water gage at 1000 fpm in the wide-open position. Frames shall not be less than 2 inches in width. Dampers shall be tested in accordance with AMCA 500-D.

c. Operating links external to dampers (such as crank arms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers) shall withstand a load equal to twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Moving parts in contact with one another shall be of different materials. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crank arms shall control the open and closed position of dampers.

2.3.2 Valves

2.3.2.1 Valve Assembly

Valves shall have stainless steel stems. Valves shall be ANSI Class 125 or ANSI Class 150, as required by the following pressure-temperature design criteria: 150 percent of the system operating pressure at the system operating temperature. Valve leakage rating shall be 0.01 percent of rated Cv. Class 125 copper alloy valve bodies and Class 150 steel or stainless steel valves shall conform to ASME B16.5 as a minimum. Cast iron valve components shall conform to ASTM A 126 Class B or C as a minimum.

2.3.2.2 Butterfly Valve Assembly

Butterfly valves shall be threaded lug type suitable for dead-end service and for modulation to the fully closed position, with noncorrosive discs, stainless steel shafts supported by bearing, and EPDM seats suitable for temperatures from minus 20 degrees F to plus 250 degrees F. Valves shall have a manual means of operation independent of the actuator.

2.3.2.3 Two-Way Valves

Two-way modulating valves shall have equal percentage characteristics.

2.3.2.4 Duct Coil and Terminal Unit Coil Valves

Provide control valves with either flare-type or solder-type ends provided for duct or terminal-unit coils. Provide flare nuts for each flare-type end valve.

2.3.3 Actuators

2.3.3.1 Electric Actuators

Provide direct drive electric actuators for all control applications, except where indicated otherwise. When operated at rated voltage, each actuator shall be capable of delivering torque required for continuous uniform motion and shall have end switch to limit travel, or shall withstand continuous stalling without damage. Actuators shall function properly with range of 85 to 110 percent of line voltage.

Provide gears manufactured from steel, copper alloy, fiber, or reinforced nylon. Provide hardened steel running shafts in sleeve bearing of copper alloy, hardened steel, nylon, or ball bearing. Provide two-position actuators of the single direction, spring return, or reversing type. Provide proportioning actuators capable of stopping at all points in the cycle and starting in either direction, from any point.

Provide reversing and proportioning actuators with limit switches to limit travel in either direction unless operator is stall type. Actuators shall have a simple switch for reversing direction, and a button to disengage clutch for manual adjustments. Provide reversible shaded pole, split capacitor, synchronous, or stepper type electric motors.

2.3.4 Output Switches

2.3.4.1 Control Relays

Shall be double pole, double throw (DPDT), UL listed, with contacts rated to the application, indicator light, and dust proof enclosure. Light indicator is lit when coil is energized and is off when coil is not energized. Relays shall be socket type, plug into a fixed base, and replaceable without need of tools or removing wiring. Encapsulated "PAM" type relays are permissible for terminal control applications.

2.4 ELECTRICAL POWER AND DISTRIBUTION

For controller power provide a new, dedicated 120 VAC 60 Hz source, three wire (black, white, and green). Run green ground wire to panel ground; conduit grounds are not sufficient.

2.4.1 Transformers

Transformers shall conform to UL 506. Power digital controllers and terminal control units (TCU's) from dedicated circuit breakers with surge protection specified. Transformers for digital controllers serving terminal equipment on lower level LANs may be grouped to have specified surge protection sized for the number of controllers on a single transformer. Provide a fuse on the transformer secondary side.

2.4.2 Surge Protection

Surge and transient protection consist of devices installed externally to digital controllers.

2.4.2.1 Power Line Surge Protection

Surge suppressors external to digital controller, shall be installed on all incoming AC power. Surge suppressor shall be rated by UL 1449, have a fault indicating light, and have clamping voltage ratings below the following levels:

a. Unit is a transient voltage surge suppressor 120 VAC/1 phase/2 wire plus ground, hard wire individual equipment protector.

b. Unit must react within 5 nanoseconds and automatically reset.

c. Voltage protection threshold, line to neutral, starts at no more than 211 volts peak on the 120 VAC line.

d. The transient voltage surge suppressor must have an independent secondary stage equal to or greater than the primary stage joule rating.

e. The primary suppression system components must be pure Silicon Avalanche Diodes.

f. Silicon Avalanche Diodes or Metal Oxide Varistors are acceptable in the independent secondary suppression system.

g. The Transient Suppression System shall incorporate an indication light which denotes whether the primary and/or secondary transient protection components is/are functioning.

h. All system functions of the Transient Suppression System must be individually fused and not short circuit the AC power line at any time.

i. The Transient Suppression System shall incorporate an EMI/RFI noise filter with a minimum attenuation of 13 dB at 10 kHz to 300 MHz.

j. The system must comply with IEEE C62.41, Class "B" requirements and be tested according to IEEE C62.45.

k. The system shall operate at -20 degrees C to +50 degrees C.

2.4.2.2 Telephone and Communication Line Surge Protection

Provide transient surge protection to protect the DDC controllers and LAN related devices from surges that occur on the phone lines (modem or direct connect) and on inter-unit LAN communications. Devices shall be UL listed.

a. The surge protection shall be a rugged package with continuous, non-interrupting protection and not use crowbar technology. Instant automatic reset after safely eliminating transient surges, induced lightning, and other forms of transient over voltages.

b. Unit must react within 5 nanoseconds using only solid-state silicone avalanche technology.

c. Unit shall be installed at the proper distance as recommended by the manufacturer.

2.4.2.3 Controller Input/Output Protection

Controller input/output points shall surge protection with optical isolation, metal oxide varistors (MOV), or silicon avalanche devices. Fuses are not permitted for surge protection.

2.4.3 Wiring

Provide complete electric wiring for DDC System, including wiring to transformer primaries. Control circuit wiring shall not run in the same conduit as power wiring over 100 volts. Circuits operating at more than 100 Volts shall be in accordance with Section 16402 INTERIOR DISTRIBUTION SYSTEM. Circuits operating at 100 Volts or less shall be defined as low voltage and shall be run in rigid or flexible conduit, metallic tubing, metal raceways or wire trays, or armored cable. Provide circuit and wiring protection as required by NFPA 70. Aluminum-sheathed cable or aluminum conduit may be used but shall not be buried in concrete. Use conduit or plenum-rated cable in HVAC plenums. HVAC plenums include the space between a drop ceiling and the architectural ceiling, within walls, and within ductwork. Protect exposed wiring from abuse and damage.

2.4.3.1 AC Control Wiring

a. Control wiring for 24 V circuits shall be insulated copper 18 AWG minimum and rated for 300 VAC service.

b. Wiring for 120 V shall be 14 AWG minimum and rated for 600 V service.

2.4.3.2 Analog Signal Wiring

Analog signal wiring shall be 18 AWG single or multiple twisted pair. Each cable shall be 100 percent shielded, and have 20 AWG drain wire. Each wire shall have insulation rated to 300 V AC. Cables shall have an overall aluminum-polyester or tinned-copper (cable-shield tape). Install analog signal wiring in conduit separate from AC power circuits.

2.5 FIRE PROTECTION DEVICES

Provide smoke detectors in return and supply air ducts on downstream side of filters in accordance with NFPA 90A, except as otherwise indicated. Provide UL listed or FM approved detectors for duct installation.

2.5.1 Smoke Detectors

Provide in each GSHP and ERV with supply air capacity greater than 2000 cfm in accordance with NFPA 90A. Locate downstream of the supply air filters and prior to any branch connection in accordance with NFPA 72.

2.6 INDICATORS

2.6.1 Thermometers

Provide bi-metal thermometers in locations as indicated. Bi-metal thermometers shall have either 9 inch scales or 3.5 inch dials and shall have insertion, immersion or averaging elements as indicated. Provide thermowells for liquid sensing applications. Select thermometer ranges so normal temperatures are approximately equal to midpoint readings on the scale.

2.6.2 Pressure Gages

a. Provide pressure gages for all pneumatic outputs. Select gage range so normal pressures are approximately equal to the midpoint readings on the scale, unless otherwise specified. Accuracy shall be plus or minus 2 percent of the range. Gages shall conform to ASME B40.1.

b. Gages indicating pneumatic outputs shall have 2 inch diameter faces. Scale shall be 0 to 30 psi, with 1 psi graduations.

c. Gages for low differential pressure measurements shall be 4 1/2 inch (nominal) size with two sets of pressure taps, and shall have a diaphragm actuated pointer, white dial with black figures, and pointer zero adjustment. Gage shall have ranges and graduations as shown. Accuracy shall be plus or minus 2 percent of scale range.

2.7 VARIABLE FREQUENCY MOTOR DRIVES

The variable frequency drive (VFD) shall convert 208, 240, or 460 volt (+/- 10%), three phase, 60 hertz (+/- 2Hz), utility grade power to adjustable voltage/frequency, three phase, AC power for stepless motor control from 5% to 105% of base speed.

2.7.1 Description

The variable frequency drive (VFD) shall produce an adjustable AC voltage/ frequency output for complete motor speed control. The VFD must meet all of the following criteria:

a. The VFD shall use sine coded Pulse Width Modulation (PWM) technology. The sine coded PWM calculations are performed by the VFD microprocessor.

b. The VFD shall use Insulated Gate Bipolar Transistors (IGBT) transistors for the inverter's three phase output.

c. The VFD shall use a three phase diode bridge converter to charge the VFD constant voltage capacitor buss.

d. The VFD shall have the ability for control by either a remote 4-20 MA or 0 to 10 VDC control signal or from a local control panel located on the VFD itself.

e. The VFD shall use microprocessor technology for VFD control. The VFD shall be programmable with a permanently mounted keypad included with each VFD.

f. The VFD shall be fully self diagnostic. No external programmers, analyzers, interrogators, or diagnostic boards, shall be needed to annunciate VFD faults or drive internal status.

2.7.2 Code Standards

VFD shall be UL listed as delivered to the end user. The VFD shall meet current National Electrical Code.

2.7.3 VFD Quality Assurance

To ensure quality, each and every VFD shall be subject to a series of in-plant quality controlled inspections before approval for shipment from the manufacture's facilities.

a. All components shall be tested prior to assembly and the complete unit shall be tested under full load conditions to ensure maximum product reliability.

b. The VFDs shall be the current standard production unit with at least 10 identical units already in the field.

c. Engineering support shall be available from the factory of the VFD. Phone support shall be free of charge to the end user for the life of the equipment. Factory support shall be available in the English language.

2.7.4 VFD Service

The VFD shall be supplied with:

a. 24 month parts and labor warranty. The warranty shall start when the system is accepted by the end user or 30 months from date of shipment.

b. Installation, operation, and troubleshooting guide(s).

c. A district service support group shall provide the following additional services:

(1) Factory trained personal on-site for start-up for up to one working day at no additional cost. Personnel shall be competent in operation and repair of the particular model of VFD that is installed.

(2) On-site training of customer personnel in basic installation, troubleshooting, and operation of VFDs at no additional cost. This training shall be conducted for up to 6 personnel at the installation site for a minimum of 4 hours.

2.7.5 Basic VFD Features

The VFD shall have the following basic features with no more then three separate internal electronic boards.

a. VFD mounted operator control keypad capable of:

(1) Remote/Local operator selection with password access.

(2) Run/Stop and manual speed commands.

(3) All programming functions.

(4) Scrolling through all display functions.

b. Digital display capable of indicating:

(1) VFD status.

(2) Frequency.

(3) RPM of motor.

(4) Phase current.

(5) Fault diagnostics in descriptive text.

(6) All programmed parameters.

c. Standard PI loop controller with input terminal for controlled variable and parameter settings made while inverter running.

d. User interface terminals for end-user remote control of VFD speed, speed feedback, and isolated form C SPDT relay energized on drive fault condition.

e. An isolated form C SPDT auxiliary relay energized on run command.

f. The VFD shall have a metal NEMA 1 enclosure.

g. The VFD shall have an adjustable carrier frequency with 16 KHz minimum upper limit.

h. The VFD shall have a built in or external line reactor with 3%

minimum impedance to protect DC buss capacitors and rectifier section diodes.

2.7.6 Programmable Parameters

The VFD shall include the following operator programmable parameters:

a. Upper limit frequency.

b. Lower limit frequency.

c. Acceleration rate.

d. Deceleration rate.

e. Variable torque volts per Hertz curve.

f. Starting voltage level.

g. Starting frequency level.

h. Display speed scaling.

i. Enable/disable auto-restart feature.

j. Enable/disable soft stall feature.

k. Motor overload level.

l. Motor stall level.

m. Jump frequency and hysteresis band.

n. PWM carrier frequency.

2.7.7 Protective Circuits and Features

a. An electronic adjustable inverse time current limit with consideration for additional heating of the motor at frequencies below 45Hz, for the protection of the motor.

b. An electronic adjustable soft stall feature, allowing the VFD to lower the frequency to a point were the motor will run at FLA when an overload condition exists at the requested frequency. The VFD will automatically return to the requested frequency when load condition permit.

c. The VFD will have a separate electronic stall at 110% VFD rated current and a separate hardware trip at 190% current.

d. The VFD shall have ground fault protection that protects output cables and motor from grounds during both starting and continuous running conditions.

e. The VFD shall have the ability to restart after the following faults:

(1) Overcurrent (drive or motor).

(2) Power outage.

(3) Phase loss.

(4) Overvoltage/Undervoltage.

e. The VFD shall restart into a rotating load without tripping or damaging the VFD or the motor.

f. The VFD shall keep a log of a minimum of four previous fault conditions, indicating type and time of occurrence in descriptive text.

g. The VFD shall be able to sustain 110% rated current for 60 sec.

h. The VFD shall respond to and record the following fault conditions:

(1) Over current (and have an indication if the over current was during acceleration, deceleration, or running).

(2) Overcurrent internal to the drive.

(3) Motor overload at start-up.

(4) Over voltage from the utility power.

(5) Motor running overload.

(6) Overvoltage during deceleration.

(7) VFD over heat.

(8) Load end ground fault.

(9) Abnormal parameters or data in VFD EEPROM.

2.7.8 Operational Conditions

The VFD shall be designed and constructed to operate within the following service conditions.

a. Ambient Temperature Range, 0 to 120 deg. F.

b. Non-condensing relative humidity to 90%.

PART 3 EXECUTION

3.1 INSTALLATION

Perform installation under supervision of competent technicians regularly employed in the installation of DDC systems.

3.1.1 Wiring Criteria

a. Input/output identification: Permanently label each field wire, cable, or pneumatic tube at each end with unique descriptive identification.

b. Rigid or flexible conduit shall be terminated at all sensors,

panels, troughs, and output devices.

c. Surge Protection: Install surge protection per manufacturer's specification.

d. Grounding: Ground controllers and cabinets to a good earth ground. Ground controller to a ground in accordance with Section 16402 INTERIOR DISTRIBUTION SYSTEM. Conduit grounding alone is not sufficient; all grounding must have a direct path to building earth ground. Ground sensor drain wire shields at controller end.

e. Contractor is responsible for correcting all associated ground loop problems.

f. Wiring in panel enclosures shall run in covered wire track.

3.1.2 Digital Controllers

Do not divide control of a single mechanical system such as an air handling unit, boiler, chiller, or terminal equipment between two or more controllers. A single controller shall manage control functions for a single mechanical system. It is permissible, however, to manage more than one mechanical system with a single controller.

3.1.3 Temperature Sensors

Provide temperature sensors in locations to sense the appropriate condition. Provide sensor where they are easy to access and service without special tools. Calibrate sensors to accuracy specified. In no case will sensors designed for one application be installed for another application.

3.1.3.1 Room Temperature Sensors

Provide on interior walls to sense average room temperature conditions. Avoid locations near heat sources or which may be covered by office furniture. Room temperature sensors should not be mounted on exterior walls when other locations are available. Mount center of sensor at 5 feet above finished floor.

3.1.3.2 Duct Temperature Sensors

a. Provide sensors in ductwork in general locations as indicated. Select specific sensor location within duct to accurately sense appropriate air temperatures. Do not locate sensors in dead air spaces or positions obstructed by ducts or equipment. Install gaskets between the sensor housing and duct wall. Seal duct and insulation penetrations.

b. String duct averaging sensors horizontally between two rigid supports in a serpentine position to sense average conditions. Insulate temperature sensing elements from supports. Provide hinged duct access doors to install averaging sensors if needed.

c. Locate freeze protection sensors in appropriate locations to sense lowest temperatures, to avoid potential problems with air stratification. Lowest horizontal pass shall be not more than 1 foot above bottom tube of coil.

3.1.3.3 Immersion Temperature Sensors

Provide thermowells for sensors measuring temperatures in liquid applications or pressure vessels. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to sense flow across entire area of well. Wells shall not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Provide thermowells with thermal transmission material within the well.

3.1.3.4 Outside Air Temperature Sensors

Provide outside air temperature sensor in weatherproof enclosure on north side of the building, away from exhaust hoods, air intakes and other areas that may affect temperature readings. Provide sun shields to protect from direct sunlight.

3.1.4 Damper Actuators

Actuators shall not be mounted in the air stream.

3.1.5 Thermometers

Provide thermometers at locations indicated. Mount thermometers to allow reading when standing on the floor.

3.1.6 Differential Pressure Sensors

a. Duct Static Pressure Sensing: Locate duct static pressure tip approximately two-thirds of distance from supply fan to end of duct with the greatest pressure drop.

b. Pumping Proof with Differential Pressure Switches: Install high pressure side between pump discharge and check valve.

c. Variable Speed Control: The cycle time and characteristics of the input signal from the differential pressure sensors shall be fully compatible with the variable speed controller. Coordinate the requirements with the provided associated equipment.

3.1.7 Pressure Gages

Pneumatic output lines shall have pressure gages mounted near the digital controllers.

3.1.8 Control Drawings

a. Post laminated copies of as-built control system drawings in mechanical room.

b. Provide 3 sets of as-built control drawings to the Owner's Representative.

3.2 Test and balance support

Controls contractor will coordinate with and provide full time on-site technical support to test and balance (TAB) personnel specified under Section 15950 HVAC TESTING/ADJUSTING/BALANCING or any other documents in

the project specification. This support shall include:

a. On-site operation of control systems for proper operating modes during all phases of balancing and testing.

b. Control setpoint adjustments for proper balancing of all relevant mechanical systems, including VAV boxes.

c. Setting all control loops with setpoints and adjustments determined by TAB personnel.

3.3 FIELD QUALITY CONTROL

3.3.1 General

a. Obtain approval of the field test plan and performance verification test plan for each phase of testing before beginning that phase of testing. Give the Owner's Representative firm written notification of planned testing at least 30 days prior to test. Notification shall be accompanied by the proposed test procedures. In no case will the Contractor be allowed to start testing without written Owner's approval of field test plan and performance verification test plan.

b. Demonstrate compliance of the heating, ventilating, and air conditioning control system with the contract documents. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Ensure that test personnel are regularly employed in the testing and calibration of DDC systems.

c. Testing will include field tests and performance verification tests. Field tests shall demonstrate proper calibration of input and output devices, and the operation of specific equipment. Performance verification test shall ensure proper execution of the sequence of operation and proper tuning of control loops.

d. Before scheduling the performance verification test, furnish field test documentation and written Certified Statement of Field Test Completion to the Owner's Representative for approval. The statement, certified by the DDC system provider, states that the installed system has been calibrated, tested, and is ready for the performance verification test. Do not start the performance verification test prior to receiving written permission from the Owner's Representative.

e. Tests are subject to oversight and approval by the Owner's Representative. The testing shall not be run during scheduled seasonal off-periods of heating and cooling systems.

3.3.2 Test Reporting for Field Testing and Performance Verification Tests

a. During and after completion of the Field Tests, and again after the Performance Verification Tests, identify, determine causes, replace, repair or calibrate equipment that fails to meet the specification, and submit a written report to the Owner's Representative.

b. Document all tests with detailed test results. Explain in detail

the nature of each failure and corrective action taken. Provide a written report containing test documentation after the Field Tests and again after the Performance Verification Tests. Convene a test review meeting at the job site to present the results to the Owner's Representative. As part of this test review meeting, demonstrate by performing all portions of the field tests or performance verification test that each failure has been corrected. Based on the report and test review meeting, the Owner's Representative will determine either the restart point or successful completion of testing. Do not retest until after receipt of written notification by the Architect/Engineer firm. At the conclusion of retest, assessment will be repeated.

3.3.3 Field Test Plan

Obtain approval of the field test plan for each phase of testing before beginning that phase of testing. Give to the Owner's Representative firm written notification of planned testing at least 45 days prior to test. Notification shall be accompanied by the proposed test procedures. In no case will the Contractor be allowed to start testing without written Owner's Representative firm approval of test procedures. The field test plan shall consist of detailed instructions for complete testing to prove performance of the heating, ventilating and air-conditioning system and digital control system and shall include tests requirements specified in the PART 3 paragraph entitled "Contractor's Field Tests".

3.3.4 Performance Verification Test Plan

Obtain approval of the performance verification test plan for each phase of testing before beginning that phase of testing. These test phases shall cover the same phases as those for the field tests. Submit this test plan along with the field test plan. In no case will the Contractor be allowed to start performance verification testing without written Owner approval of the performance verification test plan. The test plan shall consist of detailed step-by-step instructions for complete testing to prove control system maintains set points, control loops are tuned, and controllers are programmed for the correct sequence of operation. The test plan shall also cover test requirements specified in the PART 3 paragraph entitled "Performance Verification Test."

3.3.5 Contractor's Field Tests

Field tests shall include the following:

3.3.5.1 System Inspection

Observe the HVAC system in its shutdown condition. Check dampers and valves for proper normal positions. Document each position for the test report.

3.3.5.2 Calibration Accuracy and Operation of Inputs Test

Verify correct calibration and operation of input instruments. For each sensor and transmitter, including those for temperature, pressure, humidity, and air quality, record the reading at the sensor or transmitter location using calibrated test equipment. On the same table, record the corresponding reading at the digital controller for the test report. The test equipment shall have been calibrated within one year of use. Test equipment calibration shall be traceable to the measurement standards of

the National Institute of Standards and Technology.

3.3.5.3 Actuator Range Adjustment Test

With the digital controller, apply a control signal to each actuator and verify that the actuator operates properly from its normal position to full range of stroke position. Record actual spring ranges and normal positions for all modulating control valves and dampers. Include documentation in the test report.

3.3.5.4 Digital Controller Startup and Memory Test

Demonstrate that programming is not lost after a power failure, and digital controllers automatically resume proper control after a power failure.

3.3.5.5 Surge Protection Test

Show that surge protection, meeting the requirements of this specification, has been installed on incoming power to the digital controllers and on communications lines.

3.3.5.6 Application Software Operation Test

Test compliance of the application software for:

a. Ability to communicate with digital controllers, uploading and downloading of control programs

b. Text editing program: Demonstrate ability to edit the control program off line.

c. Reporting of alarm conditions: Force alarms conditions for each alarm, and ensure workstation receives alarms.

d. Reporting trend and status reports: Demonstrate ability of software to receive, display, and save trend and status reports.

3.3.6 Performance Verification Tests

Conduct the performance verification tests to demonstrate control system maintains setpoints, control loops are tuned, and controllers are programmed for the correct sequence of operation. Conduct performance verification test during seven days of continuous HVAC and DDC systems operation and before final acceptance of work. Specifically the performance verification test shall demonstrate the following:

3.3.6.1 Execution of Sequence of Operation

Demonstrate the HVAC system operates properly through the complete sequence of operation, for example seasonal, occupied/unoccupied, and warm-up. Demonstrate proper control system response for abnormal conditions by simulating these conditions. Demonstrate hardware interlocks and safeties work. Demonstrate the control system performs the correct sequence of control after a loss of power.

3.3.6.2 Control Loop Stability and Accuracy

Furnish the Owner's Representative graphed trends of control loops to demonstrate the control loop is stable and that setpoint is maintained.

Control loop response shall respond to setpoint changes and stabilize in 3 minutes. Control loop trend data shall be real time and the time between data points shall not be greater than one minute. The contractor shall provide a printer, either the project printer or temporary, at the job site for printing graphed trends. The printer shall remain on the job site throughout Performance Verification Testing to allow printing trends.

3.4 TRAINING

Submit a training course schedule, syllabus, and training materials 14 days prior to the start of training. Obtain approval of the training course before beginning that phase of training. Furnish a qualified instructor to conduct training courses for designated personnel in the maintenance and operation of the HVAC and DDC system. Orient training to the specific system being installed under this contract. Use operation and maintenance manual as the primary instructional aid in contractor provided activity personnel training. Base training on the Operations and Maintenance manuals and a DDC training manual. Manuals shall be delivered for each trainee with two additional sets delivered for archiving at the project site. Training manuals shall include an agenda, defined objectives and a detailed description of the subject matter for each lesson. Furnish audio-visual equipment and all other training materials and supplies. A training day is defined as 8 hours of classroom or lab instruction, including two 15 minute breaks and excluding lunch time, Monday through Friday, during the daytime shift in effect at the training facility. For guidance, the Contractor should assume the attendees will have a high school education and are familiar with HVAC systems.

3.4.1 DDC Training Phase I

The first class shall be taught for a period of 2 consecutive training days at least 2 weeks prior to the scheduled Performance Verification Test. The first course shall be taught in a VDOT provided facility. Training shall be classroom, but have hands-on operation of similar digital controllers. A maximum of 5 personnel will attend this course. Upon completion of this course, each student should be able to perform elementary operations and describe the general hardware architecture and functionality of the system. This course shall include but not be limited to:

a. Theory of operation

b. Hardware architecture

c. Operation of the system

d. Operator commands

e. Control sequence programming

f. Data base entry

g. Reports and logs

h. Alarm reports

i. Diagnostics

3.4.2 DDC Training Phase II

The second course shall be taught in the field, using the operating equipment at the project site for a total of 2 consecutive days. A maximum of 5 personnel will attend the course. The course shall consist of hands-on training under the constant monitoring of the instructor. Course content should duplicate DDC Training Phase I course as applied to the installed system. The instructor shall determine password issued to each student before each session. Upon completion of this course, students should be fully proficient in the operation of each system function.

-- End of Section --

SECTION 15950

HVAC TESTING/ADJUSTING/BALANCING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL(AMCA)

AMCA 203	(1990) Field Performance Measurements of Fan Systems

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	(2002) National Standards for Total System Balance

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB MASV	(1994) Procedural Standards for Measurements and Assessment of Sound and Vibration
NEBB TABES	(2005) Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA HVACTAB	(2002, 3rd Ed) HVAC Systems - Testing, Adjusting and Balancing
SMACNA Leakage Test Mnl	(1985, 1st Ed) HVAC Air Duct Leakage Test Manual

1.2 DESCRIPTION OF WORK

The work includes test, adjust, and balance (TAB) of heating, ventilating, and cooling (HVAC) air and water distribution systems including equipment, ducts, and piping which are located within, on, under, between, and adjacent to buildings.

1.2.1 Air Distribution Systems

Systems shall be tested, adjusted, and balanced (TAB'd) in compliance with this section. Obtain Owner's Representative written approval before applying insulation to exterior of air distribution systems under Section 15080 MECHANICAL INSULATION.

1.2.2 Water Distribution Systems

Systems shall be TAB'd in compliance with this section. Obtain Owner's Representative written approval before applying insulation to water distribution systems under Section 15080 MECHANICAL INSULATION. At Contractor's option and with Owner's Representative written approval, the piping systems may be insulated before systems are TAB'd. Piping insulation shall terminate immediately adjacent to each flow control valve, automatic control valve, or device. The ends of pipe insulation and the space between ends of pipe insulation and piping shall be sealed with waterproof vapor barrier coating. After completion of work under this section, the flow control valves and devices shall be insulated under Section 15080 MECHANICAL INSULATION.

1.2.3 Phasing of Work

This specification section is structured as though the HVAC construction, and thereby the TAB work, is going to be completed in a single phase. All elements of the TAB work are addressed on this premise.

1.3 DEFINITIONS

a. DALT: Duct air leakage test

b. DALT'd: Duct air leakage tested

c. Sound measurements terminology: Defined in AABC MN-1 or NEBB MASV.

d. TAB team supervisor: TAB team engineer.

e. TAB team technician: TAB team assistant.

f. TAB'd: HVAC Testing/Adjusting/Balancing procedures performed.

g. Field check group: One or more systems of the same basic type; the subgroup of a "field check group" is a "system". An example of a "system" is a supply air handler with its duct system, which is its supply, return, and outside air ducts.

h. Out-of-tolerance data: Pertains only to field checking of Certified Final DALT or Certified TAB report. When applied to DALT work, this phase means "a leakage rate measured during DALT field checking which exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction and sealant class." When applied to TAB work this phase means "a measurement taken during TAB field checking which does not fall within the range of plus 5 to minus 5 percent of the original measurement reported on the certified TAB Report for a specific parameter."

i. Season of maximum heating load: Time of year when outdoor ambient temperature at equipment installation site remains within following range throughout the period of data recording for TAB work. Indicated winter outdoor design dry bulb temperature plus 30 to minus 30 degrees Fahrenheit.

j. Season of maximum cooling load: Time of year when outdoor ambient temperature at equipment installation site remains within following range throughout the period of data recording for TAB work. Indicated summer outdoor design dry bulb temperature plus

15, minus 5 degrees Fahrenheit.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Certified DALT report;

Certified TAB report

Submit certified reports in the specified format including the above data.

SD-07 Certificates

Independent TAB agency personnel qualifications

DALT and TAB Submittal and Work Schedule

Pre-field DALT preliminary notification

Pre-field TAB engineering report

Advanced notice for TAB field work

Prerequisite HVAC Work Check Out List

1.5 DALT AND TAB SUBMITTAL AND WORK SCHEDULE

Submit this schedule, adapted for this particular contract, to the Owner's Representative for review and approval. Include with the submittal the planned calendar dates for each submittal or work item. Compliance with the following schedule is the Contractor's responsibility.

Qualify TAB Personnel: Within 45 calendar days after date of contract award, submit TAB agency and personnel qualifications.

Pre-DALT/TAB Meeting: Within 45 calendar days after the date of approval of the TAB agency and personnel, meet with the Owner's TAB representative.

Design Review Report: Within 60 calendar days after the date of the TAB agency personnel qualifications approval, submit design review report.

Pre-Field DALT Preliminary Notification: On completion of the duct installation for each system, the Contractor shall notify the Owner's Representative in writing within 5 days after completion.

Ductwork Selected for DALT: All ductwork is to be tested.

DALT Field Work: Within 48 hours of COTR's selection, complete DALT field work on selected.

Submit Pre-final DALT Report: Within one working day after completion of DALT field work, submit Pre-final DALT Report.

Separate Pre-final DALT reports may be submitted to allow phased testing from system to system.

Submit Certified Final DALT Report: Within 15 calendar days after completion of successful DALT Work Field Check, submit certified TAB report.

TAB Field Work: At a minimum of 90 calendar days prior to CCD.

Submit TAB Report: Within 15 calendar days after completion of TAB field work, submit certified TAB report.

TAB Field Check: 30 calendar days after certified Season 1 TAB report is approved by the Owner, conduct field check.

Complete TAB Work: Prior to CCD, complete all TAB work.

1.6 QUALITY ASSURANCE

1.6.1 Modifications of References

Accomplish work in accordance with referenced publications of AABC or NEBB except as modified by this section. In the references referred to herein, consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may" wherever they appear. Interpret reference to the "authority having jurisdiction," the "Administrative Authority," the "Owner," or the "Design Engineer" to mean the "Owner's Representative."

1.6.2 Certificates

1.6.2.1 Independent TAB Agency Personnel Qualifications

For agency proposed for approval, submit information certifying that the TAB agency is a first tier subcontractor who is not affiliated with any other company participating in work on this contract , including design, furnishing equipment, or construction.

Submit the following, to Owner's Representative for approval in compliance with paragraph entitled "TAB Personnel Qualification Requirements."

a. Independent certified TAB agency:

TAB agency: NEBB certification number and expiration date of current certification.

TAB team supervisor: Name and copy of AABC or NEBB TAB supervisor certificate and expiration date of current certification.

TAB team field leader: Name and documented evidence that the team field leader shall have satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this contract's bid opening date.

TAB team field technicians: Names and documented evidence that each field technician shall have satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this contract's bid opening date.

Current certificates: Registrations and certifications shall be current, and valid for the duration of this contract. Certifications which expire prior to completion of the TAB work, shall be renewed in a timely manner so that there is no lapse in registration or certification. TAB agency or TAB team personnel without a current registration or current certification shall not perform TAB work on this contract.

b. TAB Team Members: TAB team approved to accomplish work on this contract shall be full-time employees of the TAB agency. No other personnel shall do TAB work on this contract.

c. Replacement of TAB team members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the Owner's Representative.

1.6.2.2 Pre-Field DALT Preliminary Notification

a. Notification: On completion of the installation of each duct system indicated to be DALT'd, the Contractor shall notify the Owner's Representative in writing within 7 calendar days after completion.

1.6.2.3 Pre-Field TAB Engineering Report

Submit report containing the following information:

a. Step-by-step TAB procedure:

(1) Strategy: Describe the method of approach to the TAB field work from start to finish. Include in this description a complete methodology for accomplishing each seasonal TAB field work session.

(2) Procedural steps: Delineate fully the intended procedural steps to be taken by the TAB field team to accomplish the required TAB work of each air distribution system and each water distribution system. Include intended procedural steps for TAB work for subsystems and system components.

b. Pre-field data: Submit SMACNA HVACTAB data report forms with the following pre-field information filled in:

(1) Design data obtained from system drawings, specifications, and approved submittals.

(2) Notations detailing additional data to be obtained from the contract site by the TAB field team.

(3) Designate the actual data to be measured in the TAB field work.

(4) Provide a list of the types of instruments, and the measuring range of each, which are anticipated to be used for measuring in the TAB field work. By means of a keying scheme, specify on each TAB data report form submitted, which instruments will be used for measuring each item of TAB data. If the selection of which instrument to use, is to be made in the field, specify from which instruments the choice will be made. The instrument key number

shall be placed in the blank space where the measured data would be entered.

c. Prerequisite HVAC work checkout list: Provide a list of inspections and work items which are to be completed by the Contractor. This list shall be acted upon and completed by the Contractor and then submitted and approved by the Owner's Representative prior to the TAB team coming to the contract site.

At a minimum, a list of the applicable inspections and work items listed in the NEBB TABES, Section III, "Preliminary TAB Procedures" under paragraphs titled, "Air Distribution System Inspection" and "Hydronic Distribution System Inspection" shall be provided for each separate system to be TAB'd.

1.6.3 Responsibilities

The Contractor shall be responsible for ensuring compliance with the requirements of this section. The following delineation of specific work responsibilities is specified to facilitate execution of the various work efforts by personnel from separate organizations. This breakdown of specific duties is specified to facilitate adherence to the schedule listed in paragraph entitled "TAB Submittal and Work Schedule."

1.6.3.1 Contractor

a. TAB personnel: Ensure that the DALT work and the TAB work is accomplished by a group meeting the requirements specified in paragraph entitled "TAB Personnel Qualification Requirements."

b. Pre-DALT/TAB meeting: Attend the meeting with the TAB Supervisor, and ensure that a representative is present for the sheetmetal contractor, mechanical contractor, electrical contractor, and automatic temperature controls contractor.

c. HVAC documentation: Furnish one complete set of the following HVAC-related documentation to the TAB agency:

(1) Contract drawings and specifications

(2) Approved submittal data for equipment

(3) Construction work schedule

(4) Up-to-date revisions and change orders for the previously listed items

d. Submittal and work schedules: Ensure that the schedule for submittals and work required by this section and specified in paragraph entitled "TAB Submittal and Work Schedule," is met.

e. Coordination of supporting personnel:

Provide the technical personnel, such as factory representatives or HVAC controls installer required by the TAB field team to support the DALT and the TAB field measurement work.

Provide equipment mechanics to operate HVAC equipment and ductwork

mechanics to provide the field designated test ports to enable TAB field team to accomplish the DALT and the TAB field measurement work. Ensure these support personnel are present at the times required by the TAB team, and cause no delay in the DALT and the TAB field work.

Conversely, ensure that the HVAC controls installer has required support from the TAB team field leader to complete the controls check out.

f. Deficiencies: Ensure that the TAB Agency supervisor submits all Construction deficiency notifications directly to the Owner's Representative within 3 days after the deficiency is encountered. Further, the Contractor shall ensure that all such notification submittals are complete with explanation, including documentation, detailing deficiencies.

g. Prerequisite HVAC work: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Include as prerequisite work items, the deficiencies pointed out by the TAB team supervisor in the design review report.

h. Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's pre-field engineering report. Do not allow the TAB team to commence TAB field work until all of the following are completed.

(1) HVAC system installations are fully complete.

(2) HVAC prerequisite checkout work lists specified in the paragraph "Pre-Field TAB Engineering Report" have been completed, submitted, and approved. Ensure that the TAB Agency gets a copy of the approved prerequisite HVAC work checklist.

(3) DALT field checks for all systems are completed.

(4) HVAC system filters are clean for both Season 1 and Season 2 TAB field work.

i. Advance notice: Furnish to the Owner's Representative with advance written notice for the commencement of the DALT field work and for the commencement of the TAB field work.

j. Insulation work: Ensure that no insulation is installed on ducts to be DALT'd until DALT work on the subject ducts is complete. Later, ensure that openings in duct and machinery insulation coverings for TAB test ports are marked, closed and sealed.

1.6.3.2 TAB Agency

Provide the services of a TAB team which complies with the requirements of paragraph entitled "Independent TAB Agency Personnel Qualifications". The work to be performed by the TAB agency shall be limited to testing, adjusting, and balancing of HVAC air and water systems to satisfy the

requirements of this specification section.

1.6.3.3 TAB Team Supervisor

a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical DALT and TAB procedures and TAB team field work.

b. Pre-DALT/TAB meeting: Attend meeting with Contractor.

c. Design review report: Review project specifications and accompanying drawings to verify that the air systems and water systems are designed in such a way that the TAB engineer can accomplish the work in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.

d. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the pre-field engineering report, the during the DALT or TAB field work.

e. Prerequisite HVAC work checklist: Ensure the Contractor gets a copy of this checklist at the same time as the pre-field engineering report is submitted.

f. Technical assistance for DALT work.

(1) Technical assistance: Provide immediate technical assistance to TAB field team.

(2) DALT field visit: Near the end of the DALT field work effort, visit the contract site to inspect the HVAC installation and the progress of the DALT field work. Conduct a site visit to the extent necessary to verify correct procedures are being implemented and to confirm the accuracy of the Pre-final DALT Report data which has been reported. Also, sufficient evaluation shall be made to allow the TAB supervisor to issue certification of the final report. Conduct the site visit full-time for a minimum of one 8 hour workdays duration.

g. Certified Final DALT report: Certify the DALT report. This certification includes the following work:

(1) Review: Review the Pre-final DALT report data. From these field reports, prepare the Certified Final DALT report.

(2) Verification: Verify adherence, by the TAB field team, to the procedures specified in this section.

h. Technical Assistance for TAB Work: Provide immediate technical assistance to the TAB field team for the TAB work.

i. Certified TAB report: Certify the TAB report. This certification includes the following work:

(1) Review: Review the TAB field data report. From this field report, prepare the certified TAB report.

(2) Verification: Verify adherence, by the TAB field team, to the TAB plan prescribed by the pre-field engineering report and verify adherence to the procedures specified in this section.

j. Construction deficiencies: Within 3 working days after the TAB Agency has encountered any construction deficiencies, the TAB Supervisor shall submit written notification directly to the Owner's Representative, with a separate copy to the Contractor, of all such deficiencies. Provide in this submittal a complete explanation, including supporting documentation, detailing deficiencies. Where deficiencies are encountered that are believed to adversely impact successful completion of TAB, the TAB Agency shall issue notice and request direction in the notification submittal.

k. TAB Field Check: The TAB team supervisor shall attend and supervise TAB field check.

1.6.3.4 TAB Team Field Leader

a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, "Execution."

b. Full time: Be present at the contract site when DALT field work or TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.

c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC Checklist, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

1.6.4 Test Reports

1.6.4.1 Data from DALT Field Work

Report the data for the Pre-final DALT Report and Certified Final DALT Report in compliance the following requirements:

a. Report format: Submit report data on Air Duct Leakage Test Summary Report Forms as shown on Page 6-2 of SMACNA Leakage Test Mnl. In addition, submit in the report, a marked duct shop drawing which identifies each section of duct tested with assigned node numbers for each section. Node numbers shall be included in the completed report forms to identify each duct section. The report shall be reviewed and certified by the TAB supervisor.

b. The TAB supervisor shall include a copy of all calculations prepared in determining the duct surface area of each duct test section. In addition, the DALT reports shall contain copy(s) of the calibration curve for each of the DALT test orifices used for

testing.

c. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date. Instruments shall have been calibrated within one year of the date of use in the field. Instrument calibration shall be traceable to the measuring standards of the National Institute of Standards and Technology.

c. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

1.6.4.2 Certified TAB Reports

Submit Certified TAB Report in the following manner:

a. Report format: Submit the completed pre-field data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed and certified by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data shall be typewritten. Handwritten report forms or report data are not acceptable.

b. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded. Include in the TAB report continuous time versus temperature recording data of wet and dry bulb temperatures for the rooms, or zones, as designated in the following list:

(1) Data shall be measured and compiled on a continuous basis for the period in which TAB work affecting those rooms is being done.

(2) Data shall be measured/recorded only after the HVAC systems installations are complete, the systems fully balanced and the HVAC systems controls operating in fully automatic mode.

(3) Data may be compiled using direct digital controls trend logging where available. Otherwise, the Contractor shall temporarily install calibrated time versus temperature/humidity recorders for this purpose. The HVAC systems and controls shall have been fully operational a minimum of 24 hours in advance of commencing data compilation. The specified data shall be included in the TAB Report.

c. System Diagrams: Provide a system diagram in the TAB report showing the location of all terminal outlet supply, return, exhaust and transfer registers, grilles and diffusers. Use a key numbering system on the diagram which identifies each outlet contained in the outlet airflow report sheets.

d. Static Pressure Profiles: Report static pressure profiles for air duct systems. Report static pressure data for all supply, return, relief, exhaust and outside air ducts for the systems listed. The static pressure report data shall include, in

addition to NEBB/AABC required data, the following:

(1) Report supply fan, return fan, relief fan, and exhaust fan inlet and discharge static pressures.

(2) Report static pressure drop across coils, electric resistance heating coils installed in unit cabinetry or the system ductwork.

(3) Report static pressure drop across air filters, acoustic, air flow straighteners, air flow measuring stations or other pressure drop producing specialty items installed in unit cabinetry, or in the system ductwork. Examples of these specialty items are smoke detectors, white sound generators, RF shielding, wave guides, security bars, blast valves, small pipes passing through ductwork, and duct mounted humidifiers.

Do not report static pressure drop across duct fittings provided for the sole purpose of conveying air, such as elbows, transitions, offsets, plenums, manual dampers, and branch takes-offs.

(4) Report supply, return, exhaust/relief, outside air duct static pressure readings, including the following locations:

Main Duct: Take readings at four locations along the full length of the main duct. Locations shall be at 25 percent, 50 percent, 75 percent, and 100 percent of the total duct length.

Branch Main Ducts: Take readings at branch main ducts.

e. Duct Transverses: Report duct traverses for main and branch main supply, return, exhaust, relief and outside air ducts. This shall include all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Agency shall evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pitot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane."

f. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

Instrumentation, used for taking wet bulb temperature readings shall provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.

g. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

h. Performance Curves: The TAB Supervisor shall include, in the Certified TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job.

i. Calibration Curves: The TAB Supervisor shall include, in the Certified TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturis and flow orifices TAB'd on the job.

1.7 PRE-DALT/TAB MEETING

Meet with the TAB representative and the designing engineer of the HVAC systems to develop a mutual understanding relative to the details of the DALT work and TAB work requirements. Ensure that the TAB supervisor is present at this meeting. Requirements to be discussed include required submittals, work schedule, and field quality control.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 DALT PROCEDURES

3.1.1 Instruments and personnel

Provide instruments and consumables required to accomplish the DALT field work. Follow the same basic procedure specified below in paragraph titled "TAB Field Work," which include maintenance of and calibration of instruments, accuracy of measurements, preliminary procedures, field work, workmanship and treatment of deficiencies.

3.1.2 Ductwork To Be DALT'd

Test all ductwork.

3.1.3 Testing

Duct air leak test (DALT) the HVAC duct system. Use the duct class, seal class, leakage class and the leak test pressure data indicated on the drawings, to comply with the procedures specified in SMACNA Leakage Test Mnl. Testing shall be in accordance with the procedures specified in SMACNA Leakage Test Mnl, except as supplemented and modified by this section. In spite of specifications of SMACNA Leakage Test Mnl to the contrary, ductwork of construction class of 3-inch water gauge static pressure and below shall be DALT'd if indicated to be DALT'd. Complete DALT work on ductwork within 48 hours after the particular ductwork was selected for DALT. DALT work shall be conducted separately for large duct systems to enable the DALT work to be completed in 48 hours.

3.1.4 Pre-final DALT Report

After completion of the DALT work, prepare a Pre-final DALT Report using the reporting forms specified. Data required by those data report forms shall be furnished by the TAB team. Prepare the report neatly and legibly; the Pre-final DALT report shall provide the basis for the Certified Final DALT Report. TAB supervisor's shall review and certify the Pre-final DALT Report and submit this report within one day of completion of DALT field work. Verbally notify the TAB representative that the field check of the Pre-final DALT Report data can commence.

3.1.5 Quality Assurance - DALT Field Checks

Field check for accuracy selected Pre-final DALT Report data in the presence of the TAB representative. For each duct system, conduct field checks on 50 percent of the duct sections DALT'd. The TAB team field leader shall be present full-time when DALT field checking is conducted.

3.1.6 Additional Field Checks

If any of the duct sections checked for a given system are determined to be out-of-tolerance, data checking for that section shall be terminated and the associated Pre-final DALT Report data for the given system shall be disapproved. The Contractor shall make the necessary corrections and prepare a revised Pre-final DALT Report. A field check of the revised report data shall then be rescheduled with the TAB representative.

Further, if any data on the DALT Pre-final DALT report form for a given duct section is out-of-tolerance, then data for one additional duct section, preferably in the same duct system, shall be field checked as specified herein. The DALT'd duct section to be field checked shall be in addition to the original 50 percent of duct sections to be field checked.

3.1.7 Certified Final DALT Report

On successful completion of all field checks of the Pre-final DALT Report data for all systems, the TABS Supervisor shall assemble, review, certify and submit the Certified Final DALT Report to the Owner's Representative for approval.

3.1.8 Prerequisite for TAB Field Work

No TAB field work shall commence prior to the completion and approval, for all systems, of the Certified Final DALT Report.

3.2 TAB PROCEDURES

3.2.1 TAB Field Work

Test, adjust, and balance the listed HVAC systems to the state of operation indicated on and specified in the contract design documents. Conduct TAB work, including maintenance and calibration of instruments, measurement accuracy, and sound measurement work in conformance with the NEBB TABES, and NEBB MASV, except as supplemented and modified by this section. Provide instruments and consumables required to accomplish the TAB work.

3.2.2 Preliminary Procedures

Use the approved pre-field engineering report as instructions and procedures for accomplishing TAB field work. Test ports required for testing by the TAB engineer shall be located in the field by the TAB engineer during TAB field work. It shall be the responsibility of the sheet metal contractor to provide and install test ports as required by the TAB engineer.

3.2.3 TAB Air Distribution Systems

3.2.3.1 Air Handling Units (GSHP)

Air handling unit systems including fans (air handling unit fans, exhaust

fans and winter ventilation fans), coils, ducts, plenums, mixing boxes, terminal units, and air distribution devices for supply air, return air, outside air, mixed air relief air, and makeup air.

3.2.3.2 Makeup Air Units (ERU)

Makeup air unit systems including fans, coils, ducts, plenums, registers, diffusers, grilles, and louvers for supply air, return air, outside air, and mixed air.

3.2.3.3 Door Heaters (EDH)

Door heater systems, including fans, coils, and diffusers.

3.2.3.4 Unit Heaters

3.2.4 TAB Water Distribution Systems

3.2.4.1 Geothermal Water

Water systems including Geothermal loop & wells, GSHP flow, pumps, coils, system balance valves and flow measuring devices.

3.2.4.2 Rain Harvest System

Rain harvest water systems including tank(s) flow rates pumps, and system balancing valves, and flow measuring devices.

3.2.5 TAB Work on Performance Tests Without Seasonal Limitations

3.2.5.1 Performance Tests

In addition to the TAB proportionate balancing work on the air distribution systems and the water distribution systems, accomplish TAB work on the HVAC systems which directly transfer thermal energy. TAB the operational performance of the HVAC system..

3.2.5.2 Ambient Temperatures

On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. That is, record these temperatures at beginning and at the end of data taking.

3.2.5.3 Coils

Heating and cooling performance capacity tests shall be reported for Geothermal, DX for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

Total energy recovery unit performance

3.2.6 Workmanship

Conduct TAB work on specified HVAC systems until measured parameters are within plus or minus 10 percent of the design values, that is, the values specified or indicated on the contract documents.

3.2.7 Deficiencies

Strive to meet the intent of this section to maximize the performance of the equipment as designed and installed. However, if deficiencies in equipment design or installation prevent TAB work from being accomplished within the range of design values specified in the paragraph entitled "Workmanship," provide written notice as soon as possible to the Contractor and the Owner's Representative describing the deficiency and recommended correction.

Responsibility for correction of installation deficiencies is the Contractor's.

3.2.8 Data From TAB Field Work

After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and certification, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms shall be furnished by the TAB team. Except as approved otherwise in writing by the Owner's Representative, the TAB work and thereby the TAB report shall be considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled "Workmanship."

Prepare the report neatly and legibly; the pre-final TAB report shall be the final TAB report minus the TAB supervisor's review and certification. Obtain, at the contract site, the TAB supervisor's review and certification of the TAB report.

Verbally notify the TAB representative that the field check of the Certified TAB report data can commence; give this verbal notice 48 hours in advance of when the field checking shall commence. Do not schedule field check of the Certified TAB report until the specified workmanship requirements have been met or written approval of the deviations from the requirements have been received from the Owner's Representative.

3.2.9 Quality Assurance - TAB Field Checks

3.2.9.1 Field Check

During field check, the Contractor shall check, in the presence of the TAB representative, random selections of data (water, air quantities, air motion, sound level readings) recorded in the Certified TAB Report. Points and areas of field checks shall be selected by the TAB representative. Measurement and test procedures shall be the same as approved for TAB work for the Certified TAB Report.
Selections for recheck will not exceed 25 percent of the total number of reported data entries tabulated in the report.

3.2.9.2 Additional Field Checks

If any of the data checked for a given HVAC field check group are determined to be out-of-tolerance, data checking for all affected data for that group shall be terminated and the affected TAB report data for the given group shall be disapproved. The Contractor shall make the necessary corrections and prepare a revised Certified TAB Report. A field check of the revised report data shall then be rescheduled with the TAB representative.

Further, if any data on the Certified TAB Report for a given field check group is out-of-tolerance, then data for one additional field check group shall be field checked as specified herein. This increase field check work shall continue until out-of-tolerance data ceases to to be found. This additional field checking is up and above the original 25 percent of the of reported data entries to be field checked.

If there are no more of the similar field check group, additional field checking from another, but different, type of field check group shall be checked.

3.2.9.3 Prerequisite for Approval

Compliance with the field checking requirements of this section is a prerequisite for the final Owner's Representative approval of the certified TAB report submitted.

3.3 MARKING OF SETTINGS

Upon the final TAB work approval, permanently mark the settings of HVAC adjustment devices including valves, splitters, and dampers so that adjustment can be restored if disturbed at any time. The permanent markings shall indicate the settings on the adjustment devices which result in the data reported on the submitted certified TAB report.

3.4 MARKING OF TEST PORTS

The TAB team shall permanently and legibly mark and identify the location points of the duct test ports. If the ducts have exterior insulation, these markings shall be made on the exterior side of the duct insulation. The location of test ports shall be shown on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

-- End of Section --

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 709	(2001) Laminated Thermosetting Materials

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.147	Control of Hazardous Energy (Lockout/Tagout)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 100	(1996) Dictionary of Electrical and Electronics Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993; R 2001) Industrial Control and Systems: Enclosures
NEMA MG 1	(2003; R 2004) Motors and Generators
NEMA MG 10	(2001) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 1997; R 2001) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 2, "Site Construction," and Division 15, "Mechanical". This section applies to all sections of Division 16, "Electrical," of this project specification unless specified otherwise in the individual sections.

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 208Y/120 volts, three phase, four wire, 60 Hz.

1.5 SUBMITTALS

Submittals required in the sections which refer to this section shall conform to the requirements of Section 01300, "Submittal Procedures" and to the following additional requirements. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable technical publication references and other information necessary to establish contract compliance of each item to be provided. Photographs of existing installations are unacceptable and will be returned without approval.

1.5.1 Manufacturer's Catalog Data

Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's preprinted data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.

1.5.2 Reference Standard Compliance

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories Inc. (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

1.5.3 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the

Owner's Representative. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.5.4 Operation and Maintenance Manuals

Comply with the requirements of Section 01781, "Operation and Maintenance Data" and the technical sections.

1.6 QUALITY ASSURANCE

1.6.1 Regulatory Requirements

Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

1.6.2 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.6.3 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Owner's Representative.

1.7 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.8 NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.9 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to ANSI C2, NFPA 70, and requirements specified herein.

1.9.1 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment under Section 16402, "Interior Distribution System." Power wiring and conduit shall conform to Section 16402, "Interior Distribution System." Control wiring and conduit shall be provided under, and conform to the requirements of the section specifying the associated equipment.

1.9.2 Motor and Equipment

Provide electrical components of mechanical equipment, such as motors, motor starters, control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, and the electrical power circuits shall be provided under Division 16, except internal wiring for components of packaged equipment shall be provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

1.9.3 High Efficiency Motors

1.9.3.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

1.9.3.2 High Efficiency Polyphase Motors

Unless otherwise specified, polyphase motors shall be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-10 of NEMA MG 1.

1.9.4 Three-Phase Motor Protection

Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

1.10 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 15, "Mechanical."

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PAINTING OF EQUIPMENT

3.1.1 Factory Applied

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test and the additional requirements specified in the technical sections.

3.2 NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

-- End of Section --

SECTION 16234

DIESEL ENGINE-GENERATOR SETS - PRIME AND STANDBY - 10 TO 500 KW

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.2.1	(1996; Errata 2003) Square and Hex Bolts and Screws Inch Series

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(1998) Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI/ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ANSI/ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME/ANSI B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ASME/ANSI B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 126	(2004) Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 181/A 181M	(2001) Carbon Steel Forgings, for General-Purpose Piping
ASTM A 193/A 193M	(2004c) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M	(2004a) Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service or Both
ASTM A 234/A 234M	(2004) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 307	(2000) Carbon Steel Bolts and Studs, 60

000 PSI Tensile Strength

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE 115	(1995) Synchronous Machines
IEEE 421.1	(1986; R 1996) Definitions for Excitation Systems for Synchronous Machines
IEEE C37.2	(1996) Electrical Power System Device Function Numbers
ANSI/IEEE C57.13	(1993) Instrument Transformers

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(2002) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
NEMA MG 1	(2003; R 2004) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 30	(2000) Flammable and Combustible Liquids Code
NFPA 37	(2002) Installation and Use of Stationary Combustion Engines and Gas Turbines

UNDERWRITERS LABORATORIES INC. (UL)

UL 489	(2002; Rev thru May 2003) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 1236	(2002) Battery Chargers for Charging Engine-Starter Batteries

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," applies to this section with the additions and modifications specified herein.

1.3 DEFINITIONS

a. Intercooling - Cooling of charged air after it leaves turbocharger compressor.

b. IEEE Device Numbers - Described in IEEE Standard IEEE C37.2.

c. Gross and Net Bhp Ratings of Engine - Gross rating shall be total rated power output before deducting power requirements of electric motor-driven equipment. Net ratings shall be equal to gross ratings minus total power requirements of electric motor-driven accessories normally constituting part of "engine assembly."

1.4 SYSTEM DESIGN

1.4.1 Engine-Generator Set Data

Submit the following data pertaining to the engine-generator set.

a. Manufacturer of engine

b. Type or model of engine

c. Gross bhp rating of engine

e. Strokes per cycle

f. Number of cylinders

g. Bore and stroke, inches

h. Engine speed, rpm

i. Piston speed, fpm

k. kW rating of generator set at specified voltage and temperature rise per NEMA MG 1

l. kVA rating of generator and power factor

m. Induction method (naturally aspirated, turbocharged)

n. Intercooler type (air-to-air or jacket water)

o. Governor type, make and model

q. Motor starting kVA of generator set at 35 percent dip for voltage specified

1.5 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittal Procedures."

SD-02 Shop Drawings

Engine-generator unit and auxiliary equipment

Engine-generator unit electrical drawings

SD-03 Product Data

Engine-generator set

SD-10 Operation and Maintenance Data

Engine-generator unit and auxiliary equipment, Data Package 4

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data."

SD-11 Closeout Submittals

Posted operating instructions for diesel engine-generator set

Provide text for each piece of equipment according to paragraph, "POSTED OPERATING INSTRUCTIONS."

1.6 QUALITY ASSURANCE

1.6.1 Experience Requirements

Engines installed shall meet the following operating experience requirements:

a. Only electric generation service is considered equivalent experience. Engines driving pumps, compressors, or those in marine propulsion or railroad service are not acceptable.

b. Only experience on the same engine model is acceptable. Engine model is considered to be a given series or class of identical bore and stroke and of the same type of engine, such as In-line or Vee. In-line and Vee engines with identical bore and stroke are considered as two separate models.

c. Only experience with diesel-fueled engines is acceptable.

1.6.2 Drawing Requirements

1.6.2.1 Engine-Generator Unit and Auxiliary Equipment

Submit drawings pertaining to the engine-generator set and auxiliary equipment, including the following:

a. Certified outline, general arrangement (setting plan), and anchor bolt details.

b. General arrangement, size, and location of electrical interface points, and detailed elementary, schematic wiring, and interconnection diagrams of generator, exciter, governor, and other integral devices.

c. Dimensional drawings or catalog cuts of exhaust and intake

silencers, intake filters, pumps, tanks, remote radiators, starting equipment, and other auxiliary equipment not integral with the generator set.

d. Piping schematics for fuel oil and engine coolant showing pipe sizes and valve locations.

e. Engine-generator control panel.

1.7 DELIVERY, STORAGE AND HANDLING

Deliver equipment on pallets or blocking with each entire unit wrapped in heavy-duty plastic wrapping, sealed to protect unit from moisture and dirt. Plug and seal shut piping, conduit, exhaust, and air intake openings. Protect and prepare batteries for shipment as recommended by battery manufacturer. Store equipment at the site in covered enclosures, protected from atmospheric moisture, dirt, and ground water. Properly label each package on exterior of wrapping to identify enclosed equipment, contract number, manufacturer, and purchaser. Manufacturer's standard practice in product protection and identification, meeting above requirements, is acceptable.

1.8 SITE CONDITIONS

The components of the engine-generator sets, including cooling system components, pumps, fans, and similar auxiliaries, shall be capable of the conditions in the following environment:

a. Site location: New Kent County, Virginia.

1.9 EXTRA MATERIAL

1.9.1 Filters

Furnish two spare replacement elements in their original containers for each filter.

1.10 POSTED OPERATING INSTRUCTIONS

Provide operating instructions laminated between matte-surface thermoplastic sheets suitable for placement adjacent to corresponding equipment. Install operating instructions where directed.

PART 2 PRODUCTS

2.1 MATERIALS

Provide materials and equipment of manufacturers regularly engaged in production of such materials or equipment, and the manufacturer's latest standard commercial product that complies with specification requirements.

2.2 ENGINE-GENERATOR SET

Provide engine-generator sets, correctly coordinated by engine-generator manufacturer to ensure an installed rating in the environment described in paragraph entitled "Site Conditions." Each set shall consist of a water cooled diesel engine direct-connected to an ac generator having a brushless excitation system, and shall be provided with necessary accessories, auxiliaries, appurtenances, control equipment, and cooling systems,

resulting in a complete set and, except for external service connections, ready for operation. Mount each engine-generator set on a steel subbase sized to support the engine; generator-exciter, engine control panel; lubricating oil filters, heat exchangers and pump; fuel oil filters, day tanks, and pumps; jacket coolant heat exchangers and pumps; and interconnecting piping and wiring. Engine unit-mounted radiators and auxiliaries shall be mounted on engine-generator set subbase. Engine-generator set shall include electric starters, controls, and related wiring for electric starting. Batteries, battery racks and charger assembly may be mounted on the set subbase. Provide subbase with vibration isolators suitable for loads and lateral forces involved in seismic zone indicated. Isolators shall be as recommended by engine-generator set and isolator manufacturers to suit specific equipment involved. Make electrical and mechanical field connections with flexible connectors. When standard with the manufacturer, combustion air filter/silencer units and exhaust muffler units may be mounted separately from the set, and connections made to engine with corrosion-resistant flexible connections. Factory align engines and generators on subbase and securely bolt into place in accordance with manufacturer's standard practice. Paint each set, after assembly, with manufacturer's standard paints and colors. After tests and before shipping, thoroughly clean each set and retouch paint as necessary to provide complete protection to the set. Arrange sets for automatic unattended starting in addition to manual start-and-stop by control panel switches. Each engine-generator set shall be capable of automatically starting, coming up to synchronous speed, and ready to accept full rated power within 10 seconds after receipt of start signal. House each engine-generator set in a weather resistant enclosure for outdoor installation.

2.2.1 Equipment Rating and Capability

Each engine-generator set shall have a net standby rating capacity of not less than that specified on drawings at 0.8 power factor and shall be designed to supply 208Y/120-volt, 60-Hz ac output. Auxiliary equipment shall be designed for continuous duty at 100 percent of rated net capacity of engine-generator set. Cooling system components and auxiliaries shall be properly sized relative to engine coolant specified under cooling system.

2.2.2 Torsional Vibrations

Each complete engine-generator set shall be free of torsional vibrations that might endanger satisfactory operation of the set. Satisfactory operation will be considered endangered, when torsional vibration stresses exceed 5,000 psi within 10 percent above or below rated engine speed. Analysis of torsional vibrations shall be accomplished by calculations and by tests of a complete representative prototype of the engine-generator set. Results of the analysis shall be certified by a registered professional engineer.

2.3 GENERATOR SET DESIGN AND CONSTRUCTION

Isolate or shield rotating or reciprocating parts, or other parts that present a potential hazard to operating personnel.

2.3.1 Fungus Control

For electrical components, fungus control is required as follows:

a. Electrical components such as switches, fuses, contacts, and

heater elements, shall not be treated. Other materials and components which are inherently fungus-resistant or are protected by hermetic sealing need not be treated.

b. Circuit elements, not covered above and which have a temperature rise of not more than 75 degrees F when operating at full load, shall be coated with a fungus-resistant varnish conforming to. Circuit elements include, but are not limited to, cable, wire, switchboards, terminal and junction blocks, junction boxes, capacitors, and coils.

c. Circuit elements, such as motor coils, generator and transformer windings, and similar electrical components, which have a temperature rise exceeding 75 degrees F when operating at full load, shall not be coated with a fungitoxic compound. Instead, apply to such components two initial coats of varnish and one seal coat of varnish. Fungus and moisture resistant epoxy resin. Apply coats by vacuum-pressure immersion, centrifugal, pulsating pressure, or built-up method so as to fill interstices in the coils and prevent entrapment of air or moisture. Sealer coat may also be applied by brushing and spraying.

2.4 DIESEL ENGINES AND ACCESSORIES

Engines shall be two-cycle, naturally aspirated, turbocharged, or turbocharged and intercooled; or four-cycle, naturally aspirated, turbocharged or turbocharged and intercooled; vertical In-line or vertical Vee type; water cooled; designed for continuous electrical duty, stationary service. Provide each engine designed and constructed to eliminate undue heating, vibration, and wear and be efficient and trouble free in operation. Engine shall be capable of operating on diesel fuel oil.

2.4.1 Construction

Construct engine to withstand sudden changes from no load to rated load, and to preserve alignment of integral components under all conditions of operation. Design shall incorporate pressure lubrication of bearings and wrist pins, and bearing journals shall be hardened or chromium plated to provide a hard shock-resistant surface with ductile core. Counterbalance crankshafts to reduce vibration to a minimum. Crankshaft and connecting rod bearings shall be replaceable precision sleeve type. Construct piston rings of heat-resisting alloy steel or chromium plated cast-iron. Camshafts shall be gear driven, and shall be high wear-resistant, at cams and journals. Clearly indicate timing marks on crankshaft and gears. Valves shall have removable or rebuildable stem guides and seat inserts. Flywheel shall be balanced, and capable of being rotated 50 percent above the maximum rated engine rotative speed without danger of breaking or exploding. Provide flywheel housing with a drain hole at the lowest point. Provide means for turning crankshaft manually. Turbocharger lubricating oil system shall not be a separate system, but shall be a part of engine lubricating oil system.

2.4.2 Assembly

Completely factory-assemble each engine. Mount turbocharger or mechanically driven supercharger and intercooler and piping integral with the engine, on the engine.

2.4.3 Engine Speed Governing System, IEEE Device 65

Provide th engine with a speed governing system and an independently driven overspeed limiting engine shutdown device. Provide an adjustable isochronous governor, with suitable speed sensing. Governor shall maintain specified stability without hunting, cycling, or other irregularities. Governor characteristics shall conform to the following:

a. Minus 10 to plus 5 percent minimum range of speed changer expressed as a percent of rated speed.

b. Steady-state governing speed band shall not exceed plus or minus 0.25 percent expressed as a percent deviation from rated speed.

c. Transient speed deviation shall not exceed plus or minus 3.0 percent expressed as a percent of rated speed for any 50 percent load step, on or off.

d. Time to return to limits of observed speed band shall not exceed 3 seconds after sudden load change of transient speed deviation.

e. 0 percent to 5 percent minimum manual speed regulation range adjustment, expressed as a percent of rated speed.

2.4.4 Engine Protective Devices

Provide each engine with protective devices as follows:

a. Engine Shutdown: Equip each engine with shutdown devices listed. These devices shall shut down the engine by shutting off the fuel supply to fuel injectors. Shutdown devices shall be positive, direct in action and independent of the governor. Shutdown devices shall have factory-set fixed set points and shall be equipped with either auxiliary electrical contacts, relays or equivalent device for shutdown. Auxiliary contacts shall be suitable for starting battery voltage. Provide the following shutdown devices:

   (1) Overspeed device which operates when engine speed exceeds normal synchronous speed by 18 percent. Device shall require manual reset.

   (2) Pressure switch which operates when engine and turbocharger lubricating oil pressure drops below a preset value.

   (3) Temperature switch which operates when jacket coolant temperature exceeds a preset value.

   (4) Other shutdown devices as recommended or normally provided by engine manufacturer.

b. Electrical Interlocks and Alarms: Equip starting mechanism with auxiliary contacts for interlocking with generator main breaker control circuit as determined by manufacturer. Auxiliary contacts shall be suitable for starting battery voltage.

2.4.5 Engine Alarm Contact Devices

Equip each engine with alarm devices, relays, and auxiliary contacts, as

required, to actuate alarm system on associated engine control panel. Auxiliary contacts shall be suitable for starting battery voltage. Alarm devices shall have factory-set fixed set points. Provide following alarm contact devices:

a. Starting mechanism contacts or equivalent device operating to energize a portion of alarm system only when engine is running and not during cranking or shutdown.

b. Pressure switch in engine and turbocharger lubricating oil system piping from engine to operate when pressure drops below a preset value due to failure of engine-driven lubricating oil pump. In addition to alarm contacts, provide set of contacts to start an auxiliary oil pump, when such a pump is standard with engine manufacturer.

c. Temperature switch in jacket coolant discharge piping from engine to operate when temperature exceeds a preset value.

d. Other alarm devices as recommended by engine manufacturer.

2.4.6 Engine Accessories

Provide the following accessories for each engine-generator set when recommended by the manufacturer:

a. Piping on engine-generator set to inlet and outlet connections, including nonstandard companion flanges.

b. Foundation bolts, nuts, isolators, and sleeves for engine-generator set.

c. Leveling jack screws or shims, when applicable.

d. Chocks and shims for installation and leveling of engine-generator set subbase, when applicable.

e. Manually operated barring gear.

f. Indicating thermometer or temperature indicator in accordance with manufacturer's standard for engine coolant.

2.4.7 Air Intake and Exhaust Systems

Provide air intake and exhaust systems for each engine. Install field piping in accordance with manufacturer's requirements.Arrangement of air intake and exhaust systems shall be similar to that indicated and modified, as required, to suit engine furnished, subject to approval of the Owner's Representative. For two-cycle engines, provide an air intake shutoff operated by engine overspeed device.

a. Air intake filters: Provide dry type filter for each engine as standard with the engine manufacturer. Size filter to suit engine requirements at 100 percent of rated full load. Unit shall be designed to permit easy access to filter for maintenance purposes.

b. Exhaust silencers: Provide an exhaust silencer for each engine to reduce the total engine echaust noise by 30-35 & B(A)when measured with a sound level meter conforming to ANSI S1.4 (ASA 47), Type 1

or 2, 75 feet from the outlet, under full engine load and clear weather. Silencer shall be complete with handhole openings and necessary brackets for supporting purposes. Sizing of silencer shall be in accordance with engine and silencer manufacturer's recommendations. Flanged inlet and outlet connections shall be provided.

c. Expansion (flexible) joints: Provide sections of multiple corrugated stainless steel expansion joints with liners in the engine exhaust piping for each engine to absorb expansion strains and vibration in the piping. Flexible joints in exhaust piping shall be suitable for continuous operation at 200 degrees F above the normal exhaust gas temperature at 100 percent load. Air intake expansion joints shall be as specified for exhaust piping or may be reinforced rubber type suitable for the service. Joints shall be of the same size as pipe and provided with flanged connections. Air intake expansion joints may be for plain end pipe.

d. Air intake piping: Conform to manufacturer's recommendations for size, type, and connections.

e. Exhaust piping: Provide piping for each engine complete with necessary fittings, flanges, gaskets, bolts, and nuts. Pipe shall be steel conforming to ASTM A 53. Exhaust piping shall be Schedule 40 for 12 inch and smaller sizes and for larger sizes shall have wall thickness not less than 0.375 inch. Exhaust piping shall slope away from engine. Flanges shall be 150 pound slip-on forged steel welding flanges conforming to ASME/ANSI B16.5, with material in accordance with ASTM A 181/A 181M, Grade I. Fittings shall be butt-welding conforming to ASTM A 234/A 234M, with wall thickness same as adjoining piping. Built-up miter welded fittings may be used. Fittings shall be of same material as pipe. Miter angles of each individual section shall not exceed 22.5 degrees total and not more than 11.25 degrees relative to pipe axis at any one cut. Gaskets for piping shall be of high temperature asbestos-free material suitable for the service. Bolting material for exhaust flanges shall be alloy-steel bolt-studs conforming to ASTM A 193/A 193M, and alloy-steel nuts conforming to ASTM A 194/A 194M. Bolts shall be of sufficient length to obtain full bearing on nuts and shall project not more than two full threads beyond the nut.

2.5 GENERATORS AND EXCITATION AND VOLTAGE REGULATION SYSTEM

2.5.1 Generator

Provide 0.80 power factor, synchronous, ac, brushless-excited, revolving field, air-cooled, self-ventilated unit conforming to NEMA MG 1 and rated as specified in paragraph entitled "Equipment Rating and Capability." Enclosure frame shall be dripproof. Match generator speed to that of engine. Drive generator directly from engine crankshaft in a manner approved by both engine and generator manufacturers. Generator shall be capable of carrying at rated voltage and 0.8 power-factor, a load equal to net kW rating of the engine without exceeding temperature limits specified in NEMA MG 1 for standby duty. Winding insulation shall be Class F or H. An amortisseur winding shall be provided and generator and flywheel shall have sufficient flywheel effect to meet requirements of regulation specified. Generator field voltage shall be manufacturer's standard voltage. Prime power generator neutral shall be solidly grounded. Standby

generator neutral shall be solidly grounded when 4-pole transfer switch is used and shall not be bonded to ground at the generator when 3-pole transfer switch is used. Ground generator enclosure at two opposite mounting legs.

2.5.2 Excitation and Voltage Regulation Systems

Comply with IEEE 421.1.

2.5.2.1 Exciter

Integral with generator; synchronous, rotating armature, rotating rectifier, brushless or permanent magnet brushless type. Mount rotating rectifier assembly in a manner to provide ready access for inspection and replacement of rectifier diodes. Semiconductor rectifiers shall have minimum factor of safety of 300 percent for peak inverse voltage, and forward current ratings for operating conditions, including 100 percent generator output at 40 degrees C ambient. Provide safety devices for protection of rectifiers against overload currents and voltages unless design provides this protection inherently. Acceptable ratio of exciter ceiling voltage to exciter nominal voltage shall be not less than three to two.

2.5.2.2 Voltage Regulator, IEEE Device 90

Provide a solid state voltage regulator that automatically controls the generator field current through action on the exciter, and provides immunity from SCR tracking. Voltage regulator shall enable manual adjustment of set output voltage, while set is operating, by potentiometer adjustment at generator control panel. Voltage regulator shall enable parallel operation with like sets.

a. Operation: Voltage regulator shall have characteristics and sensors which enable generator to operate alone or in parallel with other generators in isochronous load sharing mode and in conjunction with common solid-state control to operate isochronously with proportional load sharing. Install instrument transformers and voltage regulator in the generator control panel along with a manual voltage setting control.

b. Regulation: Voltage regulator/excitation systems shall be capable of voltage regulation within plus or minus 2 percent from no-load to full-load. A 5 percent variation in frequency and effects of field heating shall not affect units regulation performance. System shall provide 300 percent rated generator current for at least 10 seconds to provide short-circuit current adequate to operate circuit breakers.

2.6 FUEL OIL SYSTEM

Conform to NFPA 30 and NFPA 37 and requirements herein.

2.6.1 Fuel Oil Day Tanks

Provide subbase-mounted tank with a minimum capacity of 48 hours of engine-generator set operation at full-rated load for each engine-generator set. Tank may be the standard design as provided by engine manufacturer or shall be constructed as specified in paragraph entitled "Tank Construction." Provide tank with a level gage and makeup control valve.

Include connections of indicated sizes for inlet, outlet, overflow, vent, drain, and level controller and high and low level alarm switches.

2.6.1.1 Level Alarm Switches

Provide tank-top mounted or external float cage, single-pole, single-throw type designed for use on fuel oil tanks. Arrange high level alarm switches to close on rise of liquid level, and low level alarm switches to close on fall of liquid level. Mount float cage units with isolating and drain valves. Contacts shall be suitable for starting battery voltage.

2.6.1.2 Tank Gages

Provide tank gages for fuel oil day tanks. Gages for fuel oil tanks shall be buoyant force type, with dial indicator not less than 4 inches in size and arranged for side mounting. Each dial or scale shall be calibrated for its specific tank to read from empty to full, with intermediate points of 1/4, 1/2, and 3/4.

2.6.2 Fuel Oil Filter

Provide manufacturer's standard.

2.7 LUBRICATING OIL SYSTEM

2.7.1 Auxiliary Lubricating Oil Pumps

Where recommended by the engine manufacturer, provide one pump for each engine, each suitable for "before-and-after" lubricating and cooling service as required by the engine. Equip each pump with a bypass relief valve.

2.7.2 Lubricating Oil Filtration

Provide each engine with a pressurized lubricating oil filtration system capable of filtering the full rate of oil flow from the oil pumps at maximum engine speed in accordance with standard practice of engine manufacturer. Provide means to ensure delivery of lubricating oil to vital wearing surfaces regardless of the condition of filters without removing engine from service. Filters shall provide means of automatically bypassing filter when filter becomes flow-restricting. Provide throwaway type filter elements as recommended by engine manufacturer.

2.7.3 Lubricating Oil Coolers

When recommended by engine manufacturer, provide coolers for each engine to maintain lubricating oil within temperature limits recommended by the engine manufacturer under all operating conditions. Cooling system and components shall be as specified by the engine manufacturer for use with the class of engine being provided, and cooling medium to be used. Provide engine jacket coolant from the radiator as cooling medium. Each thermostat in the oil cooling system shall be nonadjustable and factory set at the temperature recommended by the engine manufacturer.

2.7.4 Thermostatic Control Valves

When recommended and standard practice with the engine manufacturer for the proposed engine, provide a valve installed in the lubricating oil system for each engine to maintain a constant lubricating oil temperature from the

engine. Valve shall be as specified in paragraph entitled "Thermostatic Control Valves." Valve shall be capable of passing total lubricating oil flow requirement of the engine as determined by engine manufacturer with a pressure drop across the valve not to exceed 5 psi.

2.8 COOLING SYSTEM

2.8.1 Jacket Coolant Pumps

Provide one pump for each engine driven from engine crankshaft or camshaft. Each pump shall have ample capacity to circulate required flow of coolant specified through the system to remove total heat rejected from the engine and, where provided by design, from lubricating oil and intercoolers. Heat shall be rejected to jacket coolant to maintain optimum jacket coolant temperature leaving and entering engine as recommended by the engine manufacturer.

2.8.2 Radiators

Provide one radiator unit for each engine-generator set.

a. Design Conditions: Each radiator unit shall have ample capacity to remove not less than the total Btu per hour of heat rejected by its respective engine at 100 percent full-rated load to jacket coolant, to lubricating oil system, to air surrounding the engine on subbase-mounted radiator units and that necessary for turbocharger intercooler. Radiator capacity shall be rated at optimum temperature of coolant leaving engine and intercooler as recommended by the engine manufacturer. Mixture shall be to proportions recommended by the engine manufacturer to meet site conditions. Provide an antifreeze solution tester suitable for solution used.

b. Engine Subbase-Mounted Radiator Construction: Radiator fan shall direct air flow from the engine outward through the radiator. Fan may be driven directly from engine crankshaft through V-belt drive. Radiator shall have sufficient capacity to meet design conditions against a static restriction of 0.5 inch of water as may be imposed by louvers and ductwork. Cooling section shall have a tube and fin type core. Engine-driven fans shall be engine manufacturer's standard units, selected for quiet vibration-free operation. Provision shall be made for coolant expansion either by self-contained expansion tanks or separately mounted expansion tanks, as standard with manufacturer. Provide suitable guards for each fan and drive.

2.8.3 Thermostatic Control Valves

When recommended and standard with engine manufacturer for proposed engine, provide a valve installed in the jacket coolant system for each engine to maintain a constant jacket coolant temperature from the engine. Valve shall be as specified in paragraph entitled "Thermostatic Control Valves." Valve shall be capable of passing coolant flow, as determined by the engine manufacturer.

2.8.4 Starting Aids

Provide a factory-installed, electrically operated, jacket coolant heating system to ensure rapid starting. Thermostatically control heater at the

temperature recommended by engine manufacturer. Connect power leads to a junction box which shall provide fusing and manual disconnection of the heater. Include necessary equipment, piping, controls, wiring, and accessories.

2.9 ELECTRIC STARTING SYSTEM

Provide a 24 or 12 -volt dc starting battery installation for starting of each engine-generator set utilizing an electric cranking system. Electric cranking system shall be capable of rotating the engine at a speed sufficient for rapid starting in an ambient temperature of 20 degrees F. Signal for starting shall come from engine-generator set control system.

2.9.1 Cranking

Energize electric cranking system from negative polarity grounded starting batteries. Provide heavy-duty type cranking motors with capacity to crank the engine continuously to start the engine. Drive mechanism for engaging starting motors with engine flywheel shall be designed to inherently engage and release without binding. When engine starts, starting gearing shall automatically disengage and starting motors shall shut down. Automatic cranking panel shall crank engine as specified under paragraph entitled "Engine Cranking Relay."

2.9.2 Starting Battery Installation

Provide lead acid industrial engine cranking batteries designed for diesel engine starting of sufficient size and capacity in a fully charged condition to crank engine for four consecutive cycles of 30 seconds cranking followed by 120 seconds rest. Provide battery racks or enclosures, properly ventilated for the batteries and charger. Provide necessary cabling.

2.9.3 Starting Battery Charger

Provide enclosed, automatic, dual-rate, solid-state, constant voltage type battery charger having ac voltage compensation, dc voltage regulation, and current limiting. Charger shall employ transistor-controlled magnetic amplifier circuits to provide continuous taper charging. Charger shall have two ranges, float and equalize, with 0 to 24 hour equalizer time, dc cranking relay, silicon diode full-wave rectifiers, automatic surge suppressors, dc ammeter, dc voltmeter, and fused inputs and outputs. Charger shall have continuous rated output of not less than 10 amperes and conform to UL 1236.

2.10 PIPING SYSTEMS

2.10.1 Engine Jacket Coolant and Fresh Water Piping Systems

Conform to the following except that factory installed piping may conform to engine-generator set manufacturer's standards:

a. Piping: Provide seamless steel pipe, Schedule 40, ASTM A 53, Grade A.

b. Fittings and Flanges: Fittings, 2 inches or smaller, malleable iron, ANSI/ASME B16.3 300 poundthreaded type. Fittings, 2 1/2 inches and larger, steel butt-welding, ASME/ANSI B16.9. Utilize either ANSI/ASME B16.1 or Class A of ASTM A 126 for 125 pound

cast-iron flanged fittings. Flanges shall be in accordance with ASME/ANSI B16.5 for 150 pound slip-on or welding neck forged steel welding flanges, material conforming to ASTM A 181/A 181M. Provide flat face flanges for connecting to 125 pound standard cast-iron valves, fittings, and equipment connections.

c. Valves:

(1) Gate Valves: For valves, 2 inches and smaller, provide double disk, rising stem, inside screw, union bonnet type, 150 pound class bronze gate conforming to MSS SP-80. For valves, 2 1/2 inches and larger, provide double-disk, parallel seat type, hydraulic-rated, 125 psi class, outside screw and yoke type with flanged ends and bronze trim conforming to MSS SP-70. Provide stem packing of material suitable for the service encountered.

(2) Globe Valves: For valves, 2 inches and smaller, provide rising stem, inside screw, union bonnet, 125 pound class bronze valves conforming to MSS SP-80. For valves, 2 1/2 inches and larger, provide 150 pound class cast iron, flanged ends, bronze trim globe valves conforming to MSS SP-85. Valves shall have renewable composition discs suitable for the service encountered.

(3) Check Valves: MSS SP-80 or MSS SP-71, swing check type.

2.10.2 Fuel Oil and Lubricating Oil Piping System

Factory installed piping systems shall conform to engine-generator set manufacturer's standards.

2.10.3 Bolts, Studs, and Nuts

a. For Temperatures up to 450 Degrees F: Material for bolts or studs shall be ASTM A 307, Grade B, and for nuts ASTM A 194/A 194M, Grade 2. Threads and dimensions for bolts or studs shall comply with ANSI B18.2.1 for square head dimensions.

b. For Temperatures over 450 Degrees F: Material for bolts or studs shall be ASTM A 193/A 193M, Grade B7, and for nuts ASTM A 194/A 194M, Grade 7. Threads and dimensions for bolts or studs shall comply with ANSI B18.2.1for square head dimensions and with ASME B1.1 coarse thread series, for one inch and smaller.

2.11 ENGINE-GENERATOR SET CONTROLS

Provide an engine -generator control panel mounted on each engine-generator set subbase and a remote alarm panel. Manufacturer's standard electronic control panels may be provided in lieu of those specified below if they accomplish the same functions.

2.11.1 Engine -Generator Control Panel

Provide an enclosed panel fabricated of not lighter than 14 gage sheet steel in compliance with NEMA 250, Type 3R. Construct cabinet with angle iron framework, if required, for proper stiffness and support. Size cabinet to accommodate specified equipment when arranged in an orderly and approved manner. Factory-mount panel on engine unit subbase. Provide isolation mounting material between subbase and panel to isolate the panel from engine vibrations. Provide panel-mounted devices with nameplates of

laminated black gloss-finished plastic with white engraved lettering. Provide connecting piping, tubing, and wiring installed in conduit where not otherwise enclosed.

2.11.1.1 Engine Control Panel

Provide devices of the type standard with the manufacturer utilizing minimum 2 inch nominal diameter gages. Provide instruments subject to rapid pressure surges with damping devices to give a steady reading. Provide the following panel-mounted devices as a minimum:

a. Engine Controls: Install engine controls on generator control panel, except provide an emergency stop switch on the engine control panel.

b. Engine Instrumentation:

(l) Fuel oil pressure gage.

(2) Lube oil pressure gage.

(3) Coolant temperature gage.

(4) Elapsed time meter.

c. Engine Safety Circuit Devices: Provide the following devices to stop engine-generator set and to simultaneously open its main circuit breaker. Stop switch may be connected to this safety circuit when recommended by the manufacturer. Source of energy for engine safety circuit devices shall be the starting battery.

(1) Overcranking.

(2) Overspeed.

(3) Excessive coolant temperature.

(4) Dangerously low lubricating oil pressure.

2.11.1.2 Generator Control Panel

Install controls in engine-generator control panel. Provide generator controls and instrumentation as follows:

a. Generator controls

(1) Generator circuit breaker, IEEE Device 52.

(2) Voltage regulator and associated controls.

b. Generator instrumentation and metering

(1) Voltmeter and control switch.

(2) Ammeter and control switch.

(3) Three current and three voltage (potential) transformers.

c. Engine starting and stopping controls and protective equipment

(1) Engine starting switch.

(2) Engine cranking relay.

(3) Engine shutdown relay.

d. Local Alarm Panel: Provide manufacturer's standard local alarm panel suitable for operation on the starting battery voltage. Provide the following alarms with pre-shutdown alarms only for temperature and pressure conditions and shutdown alarms for all conditions:

(1) High jacket coolant temperature

(2) High lubricating oil temperature

(3) Low lubricating oil pressure

(4) Low fuel oil pressure

(5) Engine shutdown due to overspeed

(6) Engine starting failure

(7) Normal voltage supply failure

(8) Restoration of normal supply voltage

(10) Other engine-generator set abnormal conditions as recommended by the manufacturer

2.11.2 Remote Alarm Panel

Provide pre-shutdown alarms and shutdown alarms in accordance with paragraphs entitled "Generator Control Panel," and "Control Battery Charger" respectively.

2.11.3 Generator Control Panel Devices

2.11.3.1 Generator Circuit Breaker, IEEE Device 52

Provide circuit breaker having a solid-state tripping device with adjustable long-time and short-time tripping characteristics. Provide stored-energy closing mechanism for rapid and safe closing of circuit breaker against fault currents within the short-time rating of circuit breaker independent of operator's strength or effort in closing the handle. Size circuit breaker for the 100 percent full-load capacity of engine-generator set and provide lugs for indicated electrical connection.

a. Circuit Breaker Type:

(1) Molded-case, 100 percent rated

(a) NEMA AB 1 and UL 489

b. Circuit Breaker Support Structure

2.11.3.2 Generator Voltage Adjustment

Install manual voltage setting control system as specified under paragraph entitled "Voltage Regulator."

2.11.3.3 Instrument and Control Switches

Utilize rotary-enclosed, rear-mounted switches having positive means of maintaining contacts, which shall be silver-to-silver type, identifying escutcheon plates, and handle targets to indicate switch position. Utilize knurled handles for instrument switches, standard pistol grip handles for circuit breaker. Provide red and green indicating lights for circuit breaker control switches.

2.11.3.4 Indicating Lights

Provide front removable, low drain, push-to-test, indicating lights equipped with dropping resistors suitable for 120-vac service, as required and color caps as specified.

2.11.3.5 Instrument Transformers

Provide indoor, dry-type conforming to ANSI/IEEE C57.13. Coordinate mechanical and thermal ratings with circuit breakers and other apparatus in the switchboard. Provide voltage transformers as shown or as required of the nondrawout type with current-limiting primary fuses and secondary fuses.

2.11.3.6 Engine Starting Switch

Four-position rotary, enclosed rear mounting, maintained-position type. Switch positions shall be "Automatic," "Off," "Test," and "Manual" and connected to provide the following operation:

a. In "Automatic" position, engine-generator set shall start automatically in response to loss of voltage, as described in paragraph "Automatic Controls."

b. In "Off" position, engine-generator set starting circuits shall not function.

c. In "Test" position, engine may be started and brought up to speed, but engine-generator set cannot be put on line.

d. In "Manual" position, switch shall start and bring engine-generator set up to speed and then connect it to line.

2.11.3.7 Engine Cranking Relay

Provide to operate as follows:

a. When actuated, device shall close contacts to actuate engine starting system.

b. Should engine fail to start at once, cranking shall continue for 30 seconds (adjustable) after which a 120-second "off" period (adjustable) shall occur. Durations of cranking and "off" periods listed above may be modified in accordance with engine manufacturer's recommendations.

c. Repeat above described cranking cycle for four starting attempts.

d. If engine still fails to start, cranking device shall lock out further starting attempts until device is manually reset. When cranking relay locks out, an alarm light shall be energized on the panel and remain lighted until relay is manually reset.

2.11.3.8 Engine Shutdown Relay

Provide and actuate by engine protective devices as specified in paragraph "Engine Safety Circuit Devices." Shutdown relay shall disable engine starting circuits until manually reset.

2.11.3.9 Automatic Transfer Switch

Section 16262, "Automatic Transfer Switch."

2.12 MOTORS

Provide continuous-duty electric motors complying with NEMA MG 1. Nameplate horsepower ratings shall be as required to drive associated equipment under maximum specified conditions of operation without consideration of service factor. Provide induction motors with Class B insulation. Motors shall have general purpose drip-proof or totally enclosed fan-cooled enclosures as specified or shown. Motors shall have sleeve bearings or grease-lubricated ball bearings.

2.12.1 Three-Phase Motors

Provide single- or two-speed motors as specified or shown, squirrel cage type rated at engine-generator set voltage for 1/2 hp and larger units.

2.12.2 Single-Phase Motors

Provide motors rated 115 volts, 60-Hz for 1/3 hp and smaller units.

2.13 MOTOR CONTROL

Comply with requirements specified in Section 16402, "Interior Distribution System."

2.14 MISCELLANEOUS ENGINE SYSTEM REQUIREMENTS

2.14.1 Tank Construction

Construct tanks of not less than 3/16 inch steel plate with welded joints and necessary stiffeners on exterior of tank. Provide a braced structural steel framework support. Weld tank top tight and provide an access opening with dustproof, removable 24 inch cover.

2.14.2 Flange Connections

Where not otherwise indicated, provide piping connections in accordance with ANSI/ASME B16.1 for 125 pound flanges.

2.14.3 Thermostatic Control Valves

Valves shall be modulating type utilizing self-contained thermostats without the use of external bulbs, and equipped with three-way valve

action. Provide valves with one or more interchangeable thermostatic elements. Thermostat shall be nonadjustable and operating temperature shall be factory-set at temperature recommended by engine manufacturer. Provide valve designed to fail-safe, permitting flow through engine.

2.15 WIRE AND CABLE

Provide wire and cable required for a complete electrical system as shown. Comply with requirements specified in Section 16402, "Interior Distribution System."

2.16 WEATHER RESISTANT ENCLOSURE

Provide a weather resistant enclosure for generator sets. Fabricate from zinc-coated phosphatized and shop primed 16 gage minimum sheet steel in accordance with manufacturer's standard design. Provide enclosure for engine, generator, control panel, excitation equipment, voltage regulator, engine safety control, and accessories. Enclosure shall have sufficient louvered openings to allow entrance of outside air for engine and generator cooling at full load. Louvered openings shall be designed to exclude driving rain and snow. Provide properly arranged and sized hinged panels in the enclosure to allow convenient access to engine, generator, and control equipment for maintenance and operation. Provide lockable, hinged panels with spring latches to hold panels closed securely and not allow panels to vibrate. Brace housing internally to prevent excessive vibration when generator set is in operation.

2.17 VIBRATION ISOLATION SYSTEM

The isolation system shall reduce the vibration transmitted to the adjacent floor slab to a maximum of 0.0015 inch total amplitude throughout the frequency range down to 65 CPS. The manufacturer shall certify that the vibration isolation system will reduce the vibration to the limits specified.

2.18 IDENTIFICATION OF EQUIPMENT

Each major component of equipment shall have the manufacturer's name, address, and model and serial number on a nameplate securely affixed in a conspicuous place; nameplate of the distributing agent will not be acceptable. Nameplates shall not be painted.

2.19 SOURCE QUALITY CONTROL

Perform and report on factory tests prior to shipment. Provide certified copies of manufacturer's test data and results. Notify Owner's Representative before performing tests. Owner's Representative, reserves the right to witness tests. Test procedures shall conform to ASME, IEEE, and ANSI Standards, and to SAE requirements on testing, as appropriate and applicable. Ensure that measuring and indicating devices are certified correct. Tests shall indicate satisfactory operation and specified performance.

2.19.1 Engine-Generator Set Tests

Perform customary commercial factory tests on each engine-generator set, including, but not necessarily limited to, the following:

a. Perform hydrostatic test on engine water jackets and piping to

ensure that water seals and water jackets are water tight. Test report shall indicate pressure at which test was made and the results.

b. Place engine-generator set in continuous operation without stoppage for a period of not less than 8 hours. Operate not less than one hour at each load point, that is 1/2, 3/4, and full load. When stoppage becomes necessary during this period, repeat the 8-hour run.

2.19.1.1 Generator Tests

Ensure that temperature tests on one generator's windings are performed by manufacturer of generator in manufacturer's own plant. Temperature tests shall be in accordance with IEEE 115. Generator tests shall include insulation resistance and dielectric resistance. Prototype tests for generators that are physically and electrically identical to those provided under the Contract are acceptable.

PART 3 EXECUTION

3.1 PREPARATION

Use cribbing and shoring as required to protect construction from moving-in damage. Protect finished surfaces with heavy planking.

3.2 INSTALLATION

Installation shall be in strict accordance with manufacturer's instructions. Provide labor, tools, equipment, and other necessities for erection and installation of equipment. Furnish the services of one or more Diesel-Generator representative or technicians, experienced in installation and operation of the type of systems being provided, to supervise the installation.

3.2.1 Installation of Engine-Generator Sets

Install engine-generator sets on a concrete foundation as indicated. Provide vibration isolators to isolate vibrations from engine-generator set to the foundation.

3.2.2 Equipment Supports and Installation

Provide devices to support equipment not supported on engine-generator structural steel subbase as required. Fabricate required supports of structural steel sections, plates or rods, and arrange to provide rigid and sturdy support. Provide connections and fasteners required between equipment supports and building structures.

a. Batteries and Chargers: When batteries are to be stored during the construction period, follow manufacturer's instructions for charging and protection from environmental damage.

3.2.3 Instruction of Operators

After equipment is ready to be placed in service, Contractor and equipment manufacturer's representative shall fully instruct plant operators in operation and maintenance of the equipment. Posted operating instructions for diesel engine-generator set shall be provided adjacent to the unit.

3.2.4 Piping

Piping connecting the engine and equipment mounted on engine-generator subbase shall be factory installed and shall conform to manufacturer's standards for set sizes involved.

3.2.4.1 Shop Fabrication

Shop fabricate pipe to greatest extent possible. Plug ends of piping and openings prior to shipment to plant site.

3.2.4.2 Field Cleaning

Before placing in position, clean inside of black steel pipe by rapping along its full length to loosen sand, mill scale, and other foreign matter. Pipe 2 inch and larger shall have a wire brush of a diameter larger than that of the inside of the pipe drawn through its entire length several times. Before final connections are made to apparatus, wash out interior of coolant piping with water. Blow out air and fuel lines with 80 to 100 psi dry air or nitrogen.

3.2.4.3 Pickled Piping

Clean steel fuel oil piping and pickle internally by chemical cleaning. Cleaning process shall remove grease, oil, dirt, mill scale, lacquer, and corrosion products. Clean piping either by circulating cleaning solution through completed piping systems or by soaking prefabricated piping sections in a tank of solution. Provide and remove after use pumps, temporary piping connections, tanks, and other equipment required to accomplish cleaning of piping. After cleaning, thoroughly flush, drain, and dry piping and take necessary precautions to prevent rerusting before pipe is used. While cleaning, remove or isolate instrumentation, valves, and equipment installed in piping which contain bronze or brass. Cleaning solution shall not come in contact with bronze or brass. Cleaning solution shall not be circulated through engine piping systems. Provide cleaning solution of the type recommended by engine manufacturer and chemical manufacturer for the specific purpose.

3.2.4.4 Provisions for Expansion

Provide for expansion of piping subject to temperature change by using suitable flexible piping connectors, expansion joints, bends, ball joints, offsets, and loops in a manner that will prohibit development of excessive stresses between anchor points or at equipment connections. Provide bends, loops, and offsets wherever practical to prevent overstressing of piping systems due to thermal expansion and to provide adequate flexibility. A piping system may be cold sprung by an amount no greater than 50 percent of the total linear expansion to alleviate end thrusts and moments. Method of cold springing shall be as approved.

3.2.4.5 Reducing Fittings

Provide for changes in pipe size except where taps are permitted. Use of bushings is prohibited. In horizontal mains containing liquids, provide eccentric reducers.

3.2.4.6 Unions or Flanges

Provide where necessary to permit easy connection of piping and apparatus. Provide unions on valves with screwed ends. In long lines inside buildings, place unions or flanges not farther apart than 100 feet, except in pipe lines of welded construction where unions or flanges shall be placed as indicated.

3.2.4.7 Valves

Install in positions accessible for operation and repair. Install stems preferably in a vertical position with handwheels or operators on top, or install in a horizontal position. Do not install handwheels on stop valves below the valve. Install globe valves with flow direction from below the disk.

3.2.4.8 Connections to Equipment

Make piping connections to equipment shown and provide reducers, unions, and valves to make a complete installation. Make connections to equipment with unions or flanges. Provide valves the same size as piping in which they are installed.

3.2.4.9 Joints

a. Flanged Joints: Face pipe flanges true to line and thoroughly clean before assembly. Gasket faces shall be free of burrs or bruises. Make up flanged joints prior to completing the last weld in connecting piping. Coat bolt threads with a mixture of equal parts of graphite and boiled linseed oil or with an approved commercial coating.

b. Screwed Joints: Provide graphite pipe-joint compound apply to male threads only. Antiseize zinc compound may be provided. Piping shall be free of fins and burrs. Ream pipe ends or file out to size of bore; remove chips. Piping shall be in accordance with manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

Perform field tests and trial operations, and conduct field inspections, except final field inspection. Provide labor, calibrated and approved test equipment, and incidentals required for tests. Give Owner's Representative, 14 days notice of dates and times scheduled for tests, trial operations, and inspections. Rectify deficiencies and retest work affected by such deficiencies.

3.3.1 Piping Tests

Test piping system after lines have been cleaned. Test piping systems at a pressure of 1.5 times the design working pressure, and in no case less than 100 psig. Hydrostatically test piping, except for air and fuel, using water not exceeding 100 degrees F. Test air and fuel lines with clean, dry air or nitrogen. For air lines operating at pressure greater than 100 psig, test at design working pressure. During testing, remove gages, traps, and other apparatus which may be damaged by the test pressure, or valve off before conducting tests. Install a calibrated test pressure gage in the system to observe loss in pressure. Brush joints in piping system tested with air with a soapy water solution to check for leaks. Maintain required

test pressure for a sufficient length of time to enable inspection of joints and connections. Rectify defects which develop during testing, and retest piping systems until they show no defect or weakness and are tight.

3.3.2 Preliminary Operation

Align and adjust equipment to ensure proper operation as instructed by manufacturers of equipment. Lubricate equipment prior to operation in accordance with manufacturer's instructions. Operate engine-generator sets at varying loads throughout the load range for a sufficient time to demonstrate that operation is proper and that pressures and temperatures are normal and within specified limits. Operate engines for a period of time sufficient to ensure that units are ready to carry test loads specified in paragraph "Engine-Generator Set Acceptance Tests" without damage to engine parts. During this preliminary operation, check operation and ensure proper functioning of auxiliary equipment. Make necessary adjustments to equipment to place auxiliary equipment in operating condition.

3.3.3 Electrical Equipment and Materials Tests

Test procedures, inspections, and sampling shall be as specified and noted below:

a. Phase Relationship Tests: Check connections to equipment for proper phase relationship. During such check, disconnect devices which could be damaged by application of voltage or reversed phase sequence.

b. Control Panel Tests: Test and adjust meters and relays in accordance with applicable referenced specifications.

c. Insulation Resistance Tests: Test field installed cables.Minimum acceptable values of insulation resistance of circuits shall be as recommended by the manufacturer.

3.3.4 Engine-Generator Set Acceptance Tests

When installation is complete and in operating condition, notify the Owner's Representative, in writing that engine-generator sets and auxiliary equipment are ready for final field tests. Perform tests as necessary to make certain that equipment is functioning properly. Tests shall include the following:

a. A test to determine generating unit speed regulation under a gradual change from zero to full load.

b. A test to determine generating unit instantaneous speed change with 50 percent load on or off.

c. A test to ensure proper functioning of the overspeed trip.

d. An individual test of each alarm device.

e. An 8 -hour load test, 2 hours each at 50, 75, and 100 percent load at the highest ambient temperature in the area, to prove cooling system operation in the installed location.

Inspect auxiliary equipment including, but not limited to, pumps, fans,

radiators, compressors, instruments, and special valves to ensure proper operation. Auxiliary equipment may be field tested at the option of the Owner's Representative. Auxiliary equipment test shall be in accordance with the latest ASME and IEEE performance test codes, when applicable. Furnish and connect a suitable water rheostat for loading engine-generator set under test. Check oil after tests for presence of metal particles and water. Provide and install temporary instrumentation, piping, and electrical wiring and make electrical connections required for engine-generator set tests.

3.3.4.1 Test Reruns

When specified performance is not met by these tests, make such adjustments and changes, as necessary, and conduct additional tests, as necessary, to further check performance of equipment.

3.3.4.2 Failure to Meet Requirements

In the event equipment fails to meet specified performance or fails to operate satisfactorily, the Owner shall have the right to operate equipment until defects have been corrected. Equipment proved to be faulty or inadequate for service specified will be rejected, but the Owner shall have the right to operate rejected equipment until such time as new equipment is provided by the Contractor to replace equipment rejected.

3.3.4.3 Manufacturer's Field Services

Furnish the services of one or more diesel-generator representative or technicians, experienced in installation and operation of the type of systems being provided, to supervise testing, adjustment of the system, and to instruct Owner personnel.

-- End of Section --

SECTION 16262

AUTOMATIC TRANSFER SWITCH

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(2002) Operating Salt Spray (Fog) Apparatus

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.13	(1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.90.1	(2002) Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 602	(1996) Recommended Practices for Electric Systems in Health Care Facilities

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	(2000; R 2005) Industrial Control and Systems: General Requirements
NEMA ICS 2	(1996; R 2004) Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
NEMA ICS 4	(2000) Industrial Control and Systems: Terminal Blocks
NEMA ICS 6	(1993; R 2001) Industrial Control and Systems: Enclosures
NEMA ICS 10	(1999; R 2000) Industrial Control and Systems: AC Transfer Switch Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

NFPA 110 (2005) Emergency and Standby Power Systems

UNDERWRITERS LABORATORIES (UL)

UL 1008 (1996; Rev thru Aug 2003) Transfer Switch Equipment

UL 1066 (1997) Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01300 SUBMITTAL PROCEDURES:

SD-03 Product Data

Material
Equipment

List of proposed equipment and material, containing a description of each separate item.

SD-10 Operation and Maintenance Data

Switching Equipment
Instructions

Six copies of operating manual outlining step-by-step procedures for system startup, operation, and shutdown. Manual shall include manufacturer's name, model number, service manual, parts list, and brief description of equipment and basic operating features. Manufacturer's spare parts data shall be included with supply source and current cost of recommended spare parts. Six copies of maintenance manual listing routine maintenance, possible breakdowns, repairs, and troubleshooting guide. Manual shall include simplified wiring and control diagrams for system as installed.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Product

Material and equipment shall be standard products of a manufacturer regularly engaged in manufacturing the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. The experience use shall include applications in similar circumstances and of same design and rating as specified ATS. Equipment shall be capable of being serviced by a manufacturer-authorized and trained organization that is, in the Owner's Representative opinion, reasonably convenient to the site.

1.3.2 Nameplate

Nameplate showing manufacturer's name and equipment ratings shall be made of corrosion-resistant material with not less than 1/8 inch tall characters. Nameplate shall be mounted to front of enclosure and shall comply with nameplate requirements of NEMA ICS 2.

PART 2 PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCH (ATS)

ATS shall be electrically operated and mechanically held in both operating positions. ATS shall be suitable for use in standby systems described in NFPA 70. ATS shall be UL listed. ATS shall be manufactured and tested in accordance with applicable requirements of IEEE C37.90.1, IEEE C37.13, IEEE C62.41, IEEE Std 602, NEMA ICS 1, NEMA ICS 2, NEMA ICS 10, UL 1008 and UL 1066. ATS shall conform to NFPA 110. To facilitate maintenance, manufacturer's instruction manual shall provide typical maximum contact voltage drop readings under specified conditions for use during periodic maintenance. Manufacturer shall provide instructions for determination of contact integrity. ATS shall be rated for continuous duty at specified continuous current rating. ATS shall have following characteristics:

a. Voltage: 208Y/120 volts ac.

b. Number of Phases: Three.

c. Number of Wires: Four.

d. Frequency: 60 Hz.

e. Poles: Three switched and solid neutral.

f. ATS WCR: Rated to withstand short-circuit current of 10,000 amperes, RMS symmetrical.

g. Nonwelding Contacts: Rated for nonwelding of contacts when used with upstream feeder overcurrent devices shown and with available fault current specified.

2.1.1 Override Time Delay

Time delay to override monitored source deviation shall be adjustable from 0.5 to 6 seconds and factory set at 1 second. ATS shall monitor phase conductors to detect and respond to sustained voltage drop of 25 percent of nominal between any two normal source conductors and initiate transfer action to alternate source and start engine driven generator after set time period. Pickup voltage shall be adjustable from 85 to 100 percent of nominal and factory set at 90 percent. Dropout voltage shall be adjustable from 75 to 98 percent of pickup value and factory set at 90 percent of nominal.

2.1.2 Transfer Time Delay

Time delay before transfer to alternate power source shall be adjustable from 0 to 5 minutes and factory set at 0 minutes. ATS shall monitor frequency and voltage of alternate emergency power source and transfer when frequency and voltage are stabilized. Pickup voltage shall be adjustable from 85 to 100 percent of nominal and factory set at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal and factory set at 90 percent.

2.1.3 Return Time Delay

Time delay before return transfer to normal power source shall be adjustable from 0 to 60 minutes and factory set at 15 minutes. Time delay

shall be automatically defeated upon loss or sustained undervoltage of alternate power source, provided that normal supply has been restored.

2.1.4 Engine Shutdown Time Delay

Time delay shall be adjustable from 0 to 60 minutes and shall be factory set at 10 minutes.

2.1.5 Exerciser

Provide a generator exerciser timer. Run times shall be user programmable. The generator exerciser shall be selectable between load transfer and enginer run only, and shall have a fail-safe feature that will retransfer the ATS to normal during the exercise period.

2.1.6 Auxiliary Contacts

Two normally open and two normally closed auxiliary contacts rated at 20 amperes at 120 volts shall operate when ATS is connected to normal power source, and two normally open and two normally closed contacts shall operate when ATS is connected to alternate source.

2.1.7 Supplemental Features

ATS shall be furnished with the following:

a. Engine start contact.

b. Alternate source monitor.

c. Test switch to simulate normal power outage.

d. Voltage sensing. Pickup voltage adjustable from 85 to 100 percent of nominal; dropout adjustable from 75 to 98 percent of pickup.

e. Time delay bypass switch to override return time delay to normal.

f. Manual return-to-normal switch.

g. Means shall be provided in the ATS to insure that motor/transformer load inrush currents do not exceed normal starting currents. This shall be accomplished with either in-phase monitoring, time-delay transition, or load voltage decay sensing methods. If manufacturer supplies an in-phase monitoring system, the manufacturer shall indicate under what conditions a transfer cannot be accomplished. If the manufacturer supplies a time-delay transition system, the manufacturer shall supply recommendations for establishing time delay. If load voltage decay sensing is supplied, the load voltage setting shall be user programmable.

2.1.8 Operator

Manual operator conforming to UL 1008 shall be provided, and shall incorporate features to prevent operation by unauthorized personnel. ATS shall be designed for safe manual operation under full load conditions. If manual operation is accomplished by opening the door, then a dead-front shall be supplied for operator safety.

2.1.9 Override Switch

Override switch shall bypass automatic transfer controls so ATS will transfer and remain connected to alternate power source, regardless of condition of normal source.

2.1.10 Green Indicating Light

A green indicating light shall supervise/provide normal power source switch position indication and shall have a nameplate engraved NORMAL.

2.1.11 Red Indicating Light

A red indicating light shall supervise/provide alternate power source switch position indication and shall have a nameplate engraved ALTERNATE.

2.2 ENCLOSURE

ATS and accessories shall be installed in wall-mounted or free-standing, floor-mounted, NEMA ICS 6, Type 1, smooth sheet metal enclosure constructed in accordance with applicable requirements of UL 1066 and/or UL 1008. Door shall have suitable hinges, locking handle latch, and gasketed jamb. Metal gauge shall be not less than No. 14. Enclosure shall be equipped with at least two approved grounding lugs for grounding enclosure to facility ground system using No. 2/0 AWG copper conductors. Factory wiring within enclosure and field wiring terminating within enclosure shall comply with NFPA 70. If wiring is not color coded, wire shall be permanently tagged or marked near terminal at each end with wire number shown on approved detail drawing. Terminal block shall conform to NEMA ICS 4. Terminals shall be arranged for entrance of external conductors from top and bottom of enclosure as shown. Main switch terminals, including neutral terminal if used, shall be pressure type suitable for termination of external copper conductors shown.

2.2.1 Construction

Enclosure shall be constructed for ease of removal and replacement of ATS components and control devices from front without disconnection of external power conductors or removal or disassembly of major components.

2.2.2 Cleaning and Painting

Both the inside and outside surfaces of an enclosure, including means for fastening, shall be protected against corrosion by enameling, galvanizing, plating, powder coating, or other equivalent means. Protection is not required for metal parts that are inherently resistant to corrosion, bearings, sliding surfaces of hinges, or other parts where such protection is impractical. Finish shall be manufacturer's standard material, process, and color and shall be free from runs, sags, peeling, or other defects. An enclosure marked Type 1, 3R, 4 or 12 shall be acceptable if there is no visible rust at the conclusion of a salt spray (fog) test using the test method in ASTM B 117, employing a 5 percent by weight, salt solution for 24 hours. Type 4X enclosures are acceptable following performance of the above test with an exposure time of 200 hours.

2.3 TESTING

2.3.1 Factory Testing

A prototype of specified ATS shall be factory tested in accordance with UL 1008. In addition, factory tests shall be performed on each ATS as follows:

a. Insulation resistance test to ensure integrity and continuity of entire system.

b. Main switch contact resistance test.

c. Visual inspection to verify that each ATS is as specified.

d. Mechanical test to verify that ATS sections are free of mechanical hindrances.

e. Electrical tests to verify complete system electrical operation and to set up time delays and voltage sensing settings.

PART 3 EXECUTION

3.1 INSTALLATION

ATS shall be installed as shown and in accordance with approved manufacturer's instructions.

3.2 INSTRUCTIONS

Manufacturer's approved operating instructions shall be permanently secured to cabinet where operator can see them. One-line and elementary or schematic diagram shall be permanently secured to inside of front enclosure door.

3.3 SITE TESTING

Following completion of ATS installation and after making proper adjustments and settings, site tests shall be performed in accordance with manufacturer's written instructions to demonstrate that each ATS functions satisfactorily and as specified. Contractor shall advise Owner's Representative, not less than 10 working days prior to scheduled date for site testing, minimum operational tests shall include the following:

a. Insulation resistance shall be tested, both phase-to-phase and phase-to-ground.

b. Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.

c. Low phase-to-ground voltage shall be simulated for each phase of normal source.

d. Operation and settings shall be verified for specified ATS features, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.

e. Manual and automatic ATS functions shall be verified.

-- End of Section --

SECTION 16402

INTERIOR DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1	(1994) Rigid Steel Conduit - Zinc Coated
ANSI C80.3	(1994) Electrical Metallic Tubing - Zinc Coated

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(2001) Hard-Drawn Copper Wire
ASTM B 8	(2004) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

ASTM INTERNATIONAL (ASTM)

ASTM E 814	(2000) Fire Tests of Through-Penetration Fire Stops

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2003) Acceptance Testing Specifications

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
NEMA FU 1	(2002) Low Voltage Cartridge Fuses
NEMA ICS 1	(2000; R 2005) Industrial Control and Systems: General Requirements
NEMA ICS 2	(1996; R 2004) Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment
NEMA ICS 4	(2000) Industrial Control and Systems: Terminal Blocks

NEMA ICS 6	(1993; R 2001) Industrial Control and Systems: Enclosures
NEMA KS 1	(2001) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
NEMA MG 1	(2003; R 2004) Motors and Generators
NEMA MG 10	(2001) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 1997; R 2001) Energy Management Guide for Selection and Use of Single Phase Motors
NEMA RN 1	(2005) Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20	(1992; R 1997) Dry-Type Transformers for General Applications
NEMA TC 2	(2003) Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
NEMA TC 3	(2004) Polyvinyl Chloride PVC Fittings for Use with Rigid PVC Conduit and Tubing
NEMA WD 1	(1999) General Color Requirements for Wiring Devices
NEMA WD 6	(2002) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 1	(2005) Flexible Metal Conduit
UL 6	(2000; Rev thru May 2003) Rigid Metal Conduit
UL 20	(2000; Rev thru Jun 2002) General-Use Snap Switches
UL 50	(1995; Rev thru Sep 2003) Enclosures for Electrical Equipment
UL 67	(1993; Rev thru Nov 2003) Panelboards
UL 83	(2003; Rev thru Mar 2004) Thermoplastic-Insulated Wires and Cables

UL 198C	(1986; Rev thru Feb 1998)High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198E	(1988; R 1988, Bul. 1993 and 1994) Class R Fuses
UL 360	(2003) Liquid-Tight Flexible Steel Conduits
UL 467	(2004) Grounding and Bonding Equipment
UL 486A	(2003; Rev thru Apr 2004) Wire Connectors
UL 486C	(2004) Splicing Wire Connectors
UL 489	(2002; Rev thru May 2003) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	(2001; Rev thru Oct 2002) Attachment Plugs and Receptacles
UL 508	(1999; Rev thru Dec 2003) Industrial Control Equipment
UL 510	(2005) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A	(2004) Metallic Outlet Boxes
UL 514B	(2004) Conduit, Tubing and Cable Fittings
UL 514C	(1996; Rev thru Nov 2002) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 797	(2004) Electrical Metallic Tubing -- Steel
UL 869A	(1998) Reference Standard for Service Equipment
UL 870	(1995; Rev thru Jul 2003) Wireways, Auxiliary Gutters, and Associated Fittings
UL 943	(2006) Ground-Fault Circuit-Interrupters
UL 984	(1996) Hermetic Refrigerant Motor-Compressors
UL 1242	(2000; Rev thru May 2003) Electrical Intermediate Metal Conduit -- Steel

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittal Procedures."

SD-02 Shop Drawings

Panelboards

Transformers

SD-03 Product Data

Receptacles

Circuit breakers

Switches

Transformers

Enclosed circuit breakers

Motor controllers

Combination motor controllers

Manual motor starters

SD-10 Operation and Maintenance Data

Electrical Systems, Data Package 5

Submit operation and maintenance data in accordance with Section 01781, "Operation and Maintenance Data" and as specified herein.

1.4 MAINTENANCE

1.4.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. This shall include:

a. Single line diagram of the "as-built" building electrical system.

b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).

c. Manufacturers' operating and maintenance manuals on active electrical equipment.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.2 CONDUIT AND FITTINGS

Shall conform to the following:

2.2.1 Rigid Metallic Conduit

2.2.1.1 Rigid Steel Conduit (Zinc-Coated)

ANSI C80.1, UL 6.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40, and EPC-80 in accordance with NEMA TC 2.

2.2.3 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.2.4 Electrical Metallic Tubing (EMT)

UL 797, ANSI C80.3.

2.2.5 Plastic-Coated Rigid Steel and IMC Conduit

NEMA RN 1, Type 40 (40 mils thick).

2.2.6 Flexible Metal Conduit

UL 1.

2.2.6.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360.

2.2.7 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B.

2.2.7.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.7.2 Fittings for EMT

Steel compression type.

2.2.8 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3.

2.3 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.

2.3.1 Floor Outlet Boxes

Boxes shall be adjustable and concrete tight. Each outlet shall consist of

cast-metal body with threaded openings, adjustable ring, brass flange ring, and flush cover plate with threaded plugs. Provide gaskets to ensure watertight installation.

2.4 CABINETS, JUNCTION BOXES, AND PULL BOXES

Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

2.5 WIRES AND CABLES

Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.5.1 Conductors

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.5.1.1 Minimum Conductor Sizes

Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG; and for Class 3 low-energy, remote-control, alarm and signal circuits, No. 22 AWG.

2.5.2 Color Coding

Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in same raceway or box, other neutral shall be white with colored (not green) stripe. Color of ungrounded conductors in different voltage systems shall be as follows:

a. 208/120 volt, three-phase

   (1) Phase A - black

   (2) Phase B - red

   (3) Phase C - blue

b. 480/277 volt, three-phase

   (1) Phase A - brown

   (2) Phase B - orange

   (3) Phase C - yellow

2.5.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN/THHN conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.5.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.5.5 Metal-Clad Cable

Type MC cable is not allowed.

2.6 SPLICES AND TERMINATION COMPONENTS

UL 486A for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.7 DEVICE PLATES

Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. For nonmetallic boxes and fittings, other suitable plates may be provided. Plates on finished walls shall be urea or phenolic, minimum 0.03 inch wall thickness. Plates shall be same color as receptacle or toggle switch with which they are mounted. Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations."

2.8 SWITCHES

2.8.1 Toggle Switches

UL 20, totally enclosed with bodies of thermosetting plastic and mounting strap. Handles shall be white. Wiring terminals shall be screw-type, side-wired. Switches shall be rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.8.2 Switch with Red Pilot Handle

NEMA WD 1. Provide pilot lights that are integrally constructed as a part of the switch's handle. The pilot light shall be red and shall illuminate whenever the switch is closed or "on". The pilot lighted switch shall be rated 20 amps and 120 volts or 277 volts as indicated. Provide the circuit's neutral conductor to each switch with a pilot light.

2.8.3 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where

switches are rated higher than 240 volts, and for double-throw switches. Fused switches shall utilize Class R fuseholders and fuses, unless indicated otherwise. Switches serving as motor-disconnect means shall be horsepower rated. Provide switches in NEMA, enclosure as indicated per NEMA ICS 6.

2.8.4 Breakers Used as Switches

For 120- and 277-Volt fluorescent fixtures, mark breakers "SWD" in accordance with UL 489.

2.9 RECEPTACLES

UL 498 and NEMA WD 1, general grade, heavy-duty, grounding-type. Ratings and configurations shall be as indicated. Bodies shall be of white thermosetting plastic supported on a metal mounting strap. Dimensional requirements shall be per NEMA WD 6. Provide screw-type, side-wired wiring terminals. Connect grounding pole to mounting strap.

2.9.1 Duplex Receptacles

Duplex receptacles shall be 20 amperes, 125 volts.

2.9.2 Weatherproof Receptacles

Provide in cast metal box with gasketed, weatherproof, cast-metal cover plate and gasketed cap over each receptacle opening. Provide caps with a spring-hinged flap. Receptacle shall be UL listed for use in "wet locations with plug in use."

2.9.3 Ground-Fault Circuit Interrupter Receptacles

UL 943, duplex type for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFCI devices.

2.9.4 Plugs

Provide heavy-duty, rubber-covered three-, four-, or five- wire cord of required size, install plugs thereon, and attach to equipment. Plugs shall be UL listed with receptacles, complete with grounding blades. Where equipment is not available, turn over plugs and cord assemblies to the Owner.

2.10 PANELBOARDS

UL 67 and UL 50 having a short-circuit current rating as indicated. Panelboards for use as service disconnecting means shall additionally conform to UL 869A. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the drawings. Use of "Subfeed Breakers" is not acceptable unless specifically indicated otherwise. Main breaker shall be "separately" mounted "above" or "below" branch breakers. Where "space only" is indicated, make provisions for future installation of breakers. Panelboard locks shall be keyed same. Directories shall indicate load served by each circuit in panelboard.

Directories shall also indicate source of service to panelboard (e.g., Panel PA served from Panel MDP). Type directories and mount in holder behind transparent protective covering. Panelboards shall be listed and labeled for their intended use.

2.10.1 Panelboard Buses

All Panelboard Buses shall be copper. Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet.

2.10.2 Circuit Breakers

UL 489, thermal magnetic-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.10.2.1 Multipole Breakers

Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.10.2.2 Circuit Breakers for HVAC Equipment

Circuit breakers for HVAC equipment having motors (group or individual) shall be marked for use with HACR type and UL listed as HACR type.

2.11 ENCLOSED CIRCUIT BREAKERS

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit current interrupting rating as indicated. Enclosure type as indicated.

2.12 MOTOR CIRCUIT PROTECTORS (MCP)

Motor circuit protectors; NEMA AB 1 and UL 489. MCPs shall consist of an adjustable instantaneous trip circuit breaker in conjunction with a combination motor controller which provides coordinated motor circuit overload and short circuit protection. MCPs shall be rated in accordance with NFPA 70.

2.13 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch. Time-current characteristics curves of fuses serving motors or connected in series with circuit breakers shall be coordinated for proper operation. Fuses shall have voltage rating not less than circuit voltage.

2.13.1 Cartridge Fuses, Current Limiting Type (Class R)

UL 198E, Class RK-1 or RK-5. Associated fuseholders shall be Class R only.

2.13.2 Cartridge Fuses, Current Limiting Type (Classes J, L, and CC)

UL 198C, Class J for zero to 600 amperes, Class L for 601 to 6,000 amperes, and Class CC for zero to 30 amperes.

2.14 TRANSFORMERS

NEMA ST 20, general purpose, dry-type, self-cooled, ventilated. Provide transformers in NEMA 1 enclosure. Transformer shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding 115 degrees C under full-rated load in maximum ambient of 40 degrees C. Transformer of 115 degrees C temperature rise shall be capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating.

2.15 MOTORS

NEMA MG 1; hermetic-type sealed motor compressors shall also comply with UL 984. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 208-volt, 3-phase circuits shall have terminal voltage rating of 200 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating.

2.15.1 High Efficiency Single-Phase Motors

Single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11.

2.15.2 High Efficiency Polyphase Motors

Polyphase motors shall be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings shall meet or exceed energy efficient ratings in accordance with Table 12-10 of NEMA MG 1.

2.15.3 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided.

2.16 MOTOR CONTROLLERS

UL 508, NEMA ICS 1, and NEMA ICS 2. Controllers shall have thermal overload protection in each phase and shall have one spare normally open and one spare normally closed auxiliary contact. Magnetic-type motor

controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller shall have hand/off/automatic selector switch. Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in "hand" and "automatic" positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer's approved wiring diagram. For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. As an alternative, provide a manually operated, lockable, nonfused switch which disconnects motor from supply source within sight of motor. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position. Minimum short circuit withstand rating of combination motor controller shall be 10,000 rms symmetrical amperes.

2.16.1 Control Circuits

Control circuits shall have maximum voltage of 120 volts derived from a separate control source. Provide terminals and terminal boards. Provide separate control disconnect switch within controller. One secondary lead shall be fused; other shall be grounded.

2.16.2 Enclosures for Motor Controllers

NEMA ICS 6.

2.16.3 Multiple-Speed Motor Controllers and Reversible Motor Controllers

Across-the-line-type, electrically and mechanically interlocked. Multiple-speed controllers shall have compelling relays and shall be multiple-button, station-type with pilot lights for each speed.

2.16.4 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations shall be heavy duty, oil-tight design.

2.16.5 Pilot and Indicating Lights

Provide LED cluster lamps.

2.16.6 Terminal Blocks

NEMA ICS 4.

2.17 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

Single pole designed for surface mounting with overload protection and pilot lights.

2.17.1 Pilot Lights

Provide yoke-mounted, candelabra-base sockets rated 125 volts and fitted with glass or plastic jewels. Provide clear, 6 watt lamp in each pilot switch. Jewels for use with switches controlling motors shall be green; jewels for other purposes shall be white red or amber.

2.18 TELEPHONE SYSTEM

Provide system of telephone wire-supporting structures, including: conduits with pull wires terminal boxes, outlet and junction boxes, other accessories for telephone outlets, and backboards.

2.18.1 Outlet Boxes for Telephone System

Standard type, as specified herein, 4 by 4 inches. Mount flush in finished walls at height specified for outlet receptacles, unless otherwise noted. Outlet boxes for wall-mounted telephones shall be 2 by 4 by 2 1/8 inches deep; mounted at height 60 inches above finished floor. Outlet boxes for handicapped telephone station shall be 4 by 4 by 2 1/8 inches deep and mounted at height 48 inches above finished floor.

2.18.2 Cover Plates

Blank cover with same finish specified for receptacle and switch cover plates.

2.18.3 Conduit Sizing

Conduit for single outlets shall be minimum of 3/4 inch and for multiple outlets minimum of one inch. Size conduits for telephone risers to telephone cabinets, junction boxes, distribution centers, and telephone service, as indicated.

2.18.4 Backboards

Interior grade plywood, 3/4 inch thick, 4 by 8 feet minimum. Paint with gray fire resistant paint.

2.18.5 Terminal Cabinets

Construct of zinc-coated sheet steel. Cabinets shall be constructed with interior dimensions not less than those indicated. Trim shall be fitted with hinged door and flush catch. Doors shall provide maximum-size openings to the box interiors. Boxes shall be provided with 5/8 inch backboard having a two-coat insulating varnish finish. Match trim, hardware, doors, and finishes to lighting panelboards.

2.18.6 Receptacles for Telephone Service

Provide receptacles, 125 volts, 20 amperes, single phase, 60 Hz, adjacent to telephone backboards, served from panelboard circuit as indicated.

2.19 GROUNDING AND BONDING EQUIPMENT

UL 467. Ground rods shall be copper-clad steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.

2.20 NAMEPLATES

Provide as specified in Section 16050, "Basic Electrical Materials and Methods."

2.21 FIRESTOPPING MATERIALS

Provide asbestos free firestopping system capable of maintaining an effective barrier against flame and gases. System shall be UL listed and comply with ASTM E 814. Include UL system number UL listed print from manufacturer for each type of floor, wall and ceiling penetration.

2.22 WIREWAYS

UL 870. Material shall be steel galvanized 16 gage for heights and depths up to 6 by 6 inches, and 14 gage for heights and depths up to 12 by 12 inches. Provide in length required for the application with screw-cover NEMA 1 enclosure per NEMA ICS 6.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.

3.1.1 Underground Service

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

3.1.2 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.

3.1.2.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph entitled "Nameplates." Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure, shall be provided only as permitted by NFPA 70.

3.1.3 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise.

Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size shall be 1/2 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings shall be made with metal conduit in fire-rated shafts. Metal conduit shall extend through shafts for minimum distance of 6 inches. Conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors shall be firestopped. Provide asbestos free firestopping system capable of maintaining an effective barrier against flame and gases. System shall be UL listed and comply with ASTM E 814. Include UL system number UL listed print from manufacturer for each type of floor, wall and ceiling penetration.

3.1.3.1 Restrictions Applicable to EMT

a. Do not install underground.

b. Do not encase in concrete, mortar, grout, or other cementitious materials.

c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.

d. Do not use outdoors.

3.1.3.2 Nonmetallic Conduit

a. Restrictions applicable to PVC Schedule 40 and PVC Schedule 80

(1) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms and other such areas.

(2) Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.

(3) Do not use above finished floor or grade.

3.1.3.3 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph entitled "Flexible Connections."

3.1.3.4 Service Entrance Conduit, Underground

PVC, Type-EPC 40, galvanized rigid steel or steel IMC. Underground portion shall be encased in minimum of 3 inches of concrete and shall be installed minimum 18 inches below slab or grade.

3.1.3.5 Underground Conduit Other Than Service Entrance

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40. Convert nonmetallic conduit, to plastic-coated rigid, or IMC, steel conduit before rising through floor slab. Plastic coating shall extend minimum 6 inches above floor.

3.1.3.6 Conduit in Floor Slabs

Rigid steel; steel IMC; or PVC, Type EPC-40.

3.1.4 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.4.1 Conduit Installed Under Floor Slabs

Conduit run under floor slab shall be located a minimum of 12 inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.1.4.2 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finished slab.

3.1.4.3 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems shall be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Cable and conduit supports shall not be mounted to mechanical piping or ducts. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Where conduit crosses building expansion joints, provide suitable expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means.

3.1.4.4 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.4.5 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having

minimum 200-pound tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.4.6 Conduit Installed in Concrete Floor Slabs

Locate so as not to adversely affect structural strength of slabs. Install conduit within middle one-third of concrete slab. Do not stack conduits. Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends shall not be visible above finish slab. Increase slab thickness as necessary to provide minimum one inch cover over conduit. Conduit larger than one inch trade size shall be parallel with or at right angles to main reinforcement; when at right angles to reinforcement, conduit shall be close to one of supports of slab. Where nonmetallic conduit is used, raceway shall be converted to plastic coated rigid steel or plastic coated steel IMC before rising above floor, unless specifically indicated.

3.1.4.7 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.4.8 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.4.9 Flexible Connections

Provide flexible steel conduit between 3 and 6 feet in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 1/2 inch diameter. Provide liquidtight flexible metallic conduit in wet and damp locations for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.1.5 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, and when specifically indicated. Boxes in other locations shall be sheet steel, except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit system. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in

masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports, or make adequate provisions for distributing load over ceiling support members in an approved manner. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. Threaded studs driven in by powder charge and provided with lockwashers and nuts or nail-type nylon anchors may be used in lieu of wood screws, expansion shields, or machine screws. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.5.1 Boxes

Boxes for use with raceway systems shall be minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet. Telephone outlets shall be minimum of 4 inches square by 2 1/8 deep , except for wall mounted telephones and outlet boxes for handicap telephone stations.

3.1.5.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, and compatible with nonmetallic raceway systems, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.6 Mounting Heights

Mount panelboards, enclosed circuit breakers, motor controller and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor. Mount lighting switches 48 inches above finished floor, receptacles 18 inches above finished floor, and other devices as indicated. Measure mounting heights of wiring devices and outlets to center of device or outlet.

3.1.7 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with Section 15, specifications

3.1.8 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type or "twist on" connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.9 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.10 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings. Provide asbestos free firestopping system capable of maintaining an effective barrier against flame and gases. System shall be UL listed and comply with ASTM E 814. Include UL system number UL listed print from manufacturer for each type of floor, wall and ceiling penetration.

3.1.11 Grounding and Bonding

In accordance with NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telephone system grounds, and neutral conductor of wiring systems. Make ground connection at main service equipment. Provide three ground rods in compliance with NFPA 70. Interconnect all grounding media in or on the structure to provide a common ground potential. This shall include, electrical service, telephone system grounds, as well as underground metallic piping systems for rainwater collection and drinking water.Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.11.1 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 25 ohms under dry conditions. Where resistance obtained exceeds 25 ohms, contact Owner's Representative for further instructions.

3.1.11.2 Telephone Service

Provide main telephone service equipment ground consisting of separate ground wire, No. 6 AWG in conduit between equipment backboard and readily accessible grounding connection. Equipment end of ground wire shall consist of coiled length at least twice as long as terminal cabinet or backboard height.

3.1.12 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and

protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

3.1.13 Owner-Furnished Equipment

Contractor shall make connections to Owner-furnished equipment to make equipment operate as intended, including providing miscellaneous items such as plugs, receptacles, wire, cable, conduit, flexible conduit, and outlet boxes or fittings.

3.2 FIELD QUALITY CONTROL

3.2.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.2.2 Transformer Tests

Perform the standard, not optional, tests in accordance with the Inspection and Test Procedures for transformers, dry type, air-cooled, 600 volt and below; as specified in NETA ATS. Measure primary and secondary voltages for proper tap settings. Tests need not be performed by a recognized independent testing firm or independent electrical consulting firm.

3.2.3 Ground-Fault Receptacle Test

Test GFCI receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.2.4 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall.

-- End of Section --

SECTION 16510

INTERIOR LIGHTING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.42	(1995) Electric Lamps - Guidelines for High-Pressure Sodium Lamps
ANSI C78.1381	(1989; R 1997) Electric Lamps - 70-Watt M85 Metal-Halide Lamps
ANSI C82.4	(2002) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
ANSI C82.11	(1993; R 1998) High-Frequency Fluorescent Lamp Ballasts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 366/A 366M	(1997) Commercial Quality (CS) Steel, Carbon, (0.15 Maximum Percent) Cold-Rolled
ASTM A 641/A 641M	(1998) Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 653/A 653M	(2001a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 633	(1998e01) Electrodeposited Coatings of Zinc on Iron and Steel

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IES)

IES LHBK	(1993) Lighting Handbook, Reference and Application

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(1996; R 2004) Standard for Industrial Control and Systems: Controllers, Contractors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC: Part 8 - Disconnect Devices for Use in Industrial Control Equipment

NEMA ICS 6	(1993; R 2001) Industrial Control and Systems: Enclosures
NEMA LL 1	(1997; R 2002) Procedures for Linear Fluorescent Lamp Sample Preparation and the TCLP

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
NFPA 101	(2003) Life Safety Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 773	(1995; Rev thru Mar 2002) Plug-In Locking Type Photocontrols for Use with Area Lighting
UL 773A	(2006) Nonindustrial Photoelectric Switches for Lighting Control
UL 924	(2006) Emergency Lighting and Power Equipment
UL 935	(2001) Fluorescent-Lamp Ballasts
UL 1029	(1994; Rev thru Feb 2001) High-Intensity-Discharge Lamp Ballasts
UL 1570	(1995; Rev thru Nov 1999) Fluorescent Lighting Fixtures
UL 1570	(1995; Rev thru Nov 1999) Fluorescent Lighting Fixtures
UL 1572	(1995; R 1999) High Intensity Discharge Lighting Fixtures

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," applies to this section, with the additions and modifications specified herein. Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 16402, "Interior Distribution System." Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in this section.

1.3 DEFINITIONS

1.3.1 Average Life

Time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

1.3.2 Total Harmonic Distortion (THD)

The root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittal Procedures." Data, drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES LHBK, as applicable, for the lighting system specified.

SD-03 Product Data

Fluorescent lighting fixtures

Fluorescent electronic ballasts

Fluorescent lamps

High-intensity-discharge (HID) lighting fixtures

HID ballasts

High-pressure sodium (HPS) lamps

Metal-halide lamps

Lighting contactor

Time switch

Exit signs

1.5 QUALITY ASSURANCE

1.5.1 Fluorescent Electronic Ballasts

Submit ballast catalog data as required in the paragraph entitled "Fluorescent Lamp Electronic Ballasts" contained herein. As an option, submit the fluorescent fixture manufacturer's electronic ballast specification information in lieu of the actual ballast manufacturer's catalog data. This information shall include published specifications and sketches, which covers the information required by the paragraph entitled "Fluorescent Lamp Electronic Ballasts" herein. This information may be supplemented by catalog data if required, and shall contain a list of vendors with vendor part numbers.

1.6 ELECTRONIC BALLAST WARRANTY

Furnish the electronic ballast manufacturer's warranty. The warranty period shall not be less than 5 years from the date of manufacture of the electronic ballast. Ballast assembly in the lighting fixture, transportation, and on-site storage shall not exceed 12 months, thereby permitting 4 years of the ballast 5 year warranty to be in service and energized. The warranty shall state that the malfunctioning ballast shall be exchanged by the manufacturer and promptly shipped to the using Owner facility. The replacement ballast shall be identical to, or an improvement upon, the original design of the malfunctioning ballast.

PART 2 PRODUCTS

2.1 FLUORESCENT LIGHTING FIXTURES

UL 1570. Fluorescent fixtures shall have electronic ballasts unless specifically indicated otherwise.

2.1.1 Fluorescent Lamp Electronic Ballasts

The electronic ballast shall as a minimum meet the following characteristics:

a. Ballast shall comply with UL 935, ANSI C82.11, and NFPA 70 unless specified otherwise. Ballast shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.

b. Power factor shall be 0.95 (minimum).

c. Ballast shall operate at a frequency of 20,000 Hertz (minimum).

d. Ballast shall have light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation. Ballast shall have 10 percent flicker (maximum) using any compatible lamp.

e. Ballast shall be UL listed Class P with a sound rating of "A."

f. Ballast enclosure size shall conform to standards of electromagnetic ballasts. Ballast shall have circuit diagrams and lamp connections displayed on ballast packages. Ballast shall operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed.

g. Ballast shall operate in an instant start mode.

h. Electronic ballast shall have a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.

i. High efficiency type

2.1.1.1 T-8 Lamp Ballast

a. Ballast shall be capable of starting and maintaining operation at a minimum of 50 degrees F for F32T8 lamps, unless otherwise indicated.

b. Total harmonic distortion (THD): Shall be 20 percent (maximum).

c. Ballst Factor: Shall be .87 (minimum).

2.1.1.2 F17T8 Lamp Ballast

a. Ballast shall be capable of starting maintaining operation at a minimum of 50 degrees F for F17T8 lamps, unless otherwise indicated.

b. Total harmonic distortion (THD): Shall be 20 percent (maximum).

c. Input wattage:

(1) 17 watts (maximum) when operating one F17T8 lamps.

2.1.2 T-8 Lamp Ballast

Input wattage, for indicated lamp quantity shall be:

(1) 30 watts (maximum) when operating one F32T8 lamp.

(2) 55 watts (maximum) when operating two F32T8 lamps.

(3) 82 watts (maximum) when operating three F32T8 lamps.

2.1.3 Fluorescent Lamps

a. T-8 rapid start low mercury lamps shall be rated 32 watts (maximum), 2900 initial lumens (minimum), CRI of 75 (minimum), color temperature of 3500 K, and an average rated life of 20,000 hours. Low mercury lamps shall have passed the EPA Toxicity Characteristic Leading Procedure (TCLP) for mercury by using the lamp sample preparation procedure described in NEMA LL 1.

b. T-8 rapid start low mercury lamp, 17 watt (maximum), nominal length of 24 inches, 1400 initial lumens, CRI of 75 (minimum), color temperature of 3500 K, and an average rated life of 20,000 hours. Low mercury lamps shall have passed the EPA Toxicity Characteristic Leading Procedure (TCLP) for mercury by using the lamp sample preparation procedure described in NEMA LL 1.

c. Compact fluorescent lamps shall be: CRI 80, minimum, 10,000 hours average rated life, and as follows:

(1) T-4, double twin tube, rated 26 watts, 1800 initial lumens (minimum), 3500K.

(2) T-4, triple twin tube, rated 42 watts, 3200 initial lumens (minimum), 2700K.

Average rated life is based on 3 hours operating per start.

2.1.4 Compact Fluorescent Fixtures

Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballasts integral to the fixture. Providing assemblies designed to retrofit incandescent fixtures is prohibited except when specifically indicated for renovation of existing fixtures. Fixtures shall use lamps as indicated. Ballast shall be 1.0 Ballast Factor.

2.2 HIGH-INTENSITY-DISCHARGE (HID) LIGHTING FIXTURES

UL 1572. Provide HID fixtures with tempered glass lenses when using metal-halide lamps.

2.2.1 HID Ballasts

UL 1029 and ANSI C82.4 and shall be pulse start constant wattage autotransformer (CWA) or regulator, high power factor type. Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

a. Designed to operate on the voltage system to which they are connected.

b. Designed for installation in a normal ambient temperature of 40 degrees C.

c. Constructed so that open circuit operation will not reduce the average life.

High-pressure sodium (HPS) ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 3500 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C in any mode.

2.2.2 High-Pressure Sodium (HPS) Lamps

ANSI C78.42 wattage as indicated.

2.2.3 Metal-Halide Lamps

a. 70 watt conforming to ANSI C78.1381

2.3 RECESS- AND FLUSH-MOUNTED FIXTURES

Provide type that can be relamped from the bottom. Access to ballast shall be from the bottom. Trim for the exposed surface of flush-mounted fixtures shall be as indicated.

2.4 SUSPENDED FIXTURES

Provide hangers capable of supporting twice the combined weight of fixtures supported by hangers. Hangers shall allow fixtures to swing within an angle of 20 degrees. Brace pendants 4 feet or longer to limit swinging. Single-unit suspended fluorescent fixtures shall have twin-stem hangers. Multiple-unit or continuous row fluorescent fixtures shall have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end. Rods shall be a minimum 0.18 inch diameter.

2.5 LIGHTING CONTACTOR

NEMA ICS 2, mechanically held contactor. Rate contactor as indicated. Provide in NEMA 1 enclosure conforming to NEMA ICS 6. Contactor shall have silver alloy double-break contacts and coil clearing contacts for mechanically held contactor. Provide contactor with hand-off-automatic selector switch.

2.6 TIME SWITCH

Astronomic dial type or electronic type, arranged to turn "ON" at sunset and turn "OFF" at predetermined time between 8:30 p.m. and 2:30 a.m. or sunrise, automatically changing the settings each day in accordance with

seasonal changes of sunset and sunrise. Provide switch having automatically wound spring mechanism or capacitor, to maintain accurate time for a minimum of 15 hours following power failure. Provide time switch with a manual on-off bypass switch. Housing for the time switch shall be surface mounted, NEMA 1 enclosure conforming to NEMA ICS 6.

2.7 PHOTOCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated 120 volts ac, 60 Hz with single-throw contacts. A time delay shall prevent accidental switching from transient light sources. Provide switch in a cast weatherproof aluminum housing with adjustable window slide, rated 1800 VA, minimum.

2.8 EXIT SIGNS

UL 924, NFPA 70, and NFPA 101. Exit signs shall be self-powered type.

2.8.1 Self-Powered LED Type Exit Signs (Battery Backup)

Provide with automatic power failure device, test switch, pilot light, integral self-testing module and fully automatic high/low trickle charger in a self-contained power pack. Battery shall be sealed electrolyte type, shall operate unattended, and require no maintenance, including no additional water, for a period of not less than 5 years. LED exit sign shall have emergency run time of 1 1/2 hours (minimum).

2.9 SELF-TESTING MODULE

Self-testing module for exit signs shall perform the following functions:

a. Continuous monitoring of charger operation and battery voltage with visual indication of normal operation and of malfunction.

b. Monthly discharge cycling of battery with monitoring of transfer circuit function, battery capacity and emergency lamp operation with visual indication of malfunction. The battery capacity test may be conducted by using a synthetic load.

c. Manual test switch to simulate a discharge test cycle.

d. Module shall have low voltage battery disconnect (LVD) and brown-out protection circuit.

2.10 SUPPORT HANGERS FOR LIGHTING FIXTURES IN SUSPENDED CEILINGS

2.10.1 Wires

ASTM A 641/A 641M, Class 3, soft temper, zinc-coated finish,12.

2.10.2 Straps

Galvanized steel, one by 3/16 inch, conforming to ASTM A 653/A 653M, with a light commercial zinc coating or ASTM A 366/A 366M with an electrodeposited zinc coating conforming to ASTM B 633, Type RS.

2.10.3 Rods

Threaded steel rods, 3/16 inch diameter, zinc or cadmium coated.

PART 3 EXECUTION

3.1 INSTALLATION

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings. Installation shall meet requirements of NFPA 70. Mounting heights specified or indicated shall be to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Recessed and semi-recessed fixtures may be supported from suspended ceiling support system ceiling tees when the ceiling system support wires or straps or rods are provided at a minimum of four wires or straps or rods per fixture and located not more than 6 inches from each corner of each fixture. For recessed fixtures, provide support clips securely fastened to ceiling grid members, a minimum of one at or near each corner of each fixture. Provide wires, straps or rods for lighting fixture support in this section.

3.1.1 Exit Signs

Wire exit signs and emergency lighting units ahead of the switch to the normal lighting circuit located in the same room or area.

3.2 FIELD QUALITY CONTROL

Upon completion of installation, conduct an operating test to show that equipment operates in accordance with requirements of this section.

-- End of Section --

SECTION 16520

EXTERIOR LIGHTING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO LTS3	(1994; R 1998) Structural Supports for Highway Signs, Luminaires and Traffic Signals

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code
ANSI C78.42	(1995) Electric Lamps - Guidelines for High-Pressure Sodium Lamps
ANSI C82.4	(2002) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
ANSI C136.3	(1995) Roadway Lighting Equipment - Luminaire Attachments
ANSI C136.13	(1992) Roadway Lighting Equipment, Metal Brackets for Wood Poles
ANSI C136.14	(1988) Roadway Lighting Equipment - Enclosed Side-Mounted Luminaires for Horizontal-Burning High-Intensity-Discharge Lamps
ANSI C136.21	(1987; R 1997) Roadway Lighting - Vertical Tenons Used with Post-Top-Mounted Luminaires

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 153/A 153M	(2004) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code

UNDERWRITERS LABORATORIES INC. (UL)

UL 1029	(1994; Rev thru Feb 2001)

	High-Intensity-Discharge Lamp Ballasts
UL 1572	(1995; R 1999) High Intensity Discharge Lighting Fixtures

1.2 RELATED REQUIREMENTS

Section 16050, "Basic Electrical Materials and Methods," applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

1.3.1 Average Life

Time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

1.3.2 Groundline Section

That portion between one foot above and 2 feet below the groundline.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittal Procedures."

SD-03 Product Data

Luminaires

Lamps

Ballasts

Steel poles

Brackets

1.5 QUALITY ASSURANCE

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Steel Poles

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 16402, "Interior Distribution System". Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in Section 16510, "Interior Lighting."

2.2 LUMINAIRES

ANSI C136.14 or UL 1572. Provide luminaires as indicated. Provide luminaires complete with lamps of number, type, and wattage indicated. Details, shapes, and dimensions are indicative of the general type desired, but are not intended to restrict selection to luminaires of a particular manufacturer. Luminaires of similar designs , light distribution and brightness characteristics, and of equal finish and quality will be acceptable as approved.

2.2.1 Lamps

2.2.1.1 High-Pressure Sodium (HPS) Lamps

ANSI C78.42 Wattage as indicated. HPS lamps shall have average rated life of 16,000 hours (minimum) for 35 watt lamps and 24,000 hours (minimum) for all higher wattage lamps. 150 watt lamps, if required, shall be 55 volt lamps.

2.2.1.2 Standby HPS Lamps

ANSI C78.42 Wattage as indicated. Standby HPS lamps shall have two arc tubes and an average rated life of 40,000 hours (minimum). Hot restart instant lumen output shall be 8 percent, minimum, of total light output. 150 watt lamps, if required, shall be 55 volt type.

2.2.1.3 High-Pressure Sodium (HPS) lamps

ANDSI C78.42 Wattage as indicated. HPS lamps shall have average rated life of 16,000 hours (minimum) for 35 watt lamps and 24,000 hours (minimum for all higher wattage lamps. 150 watt lamps, if required, shall be 55 volt lamps.

2.2.2 Ballasts for High-Intensity-Discharge (HID) Luminaires

UL 1029 and ANSI C82.4, and shall be constant wattage autotransformer (CWA) or regulator, high power-factor type. Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

a. Designed to operate on voltage system to which they are connected.

b. Constructed so that open circuit operation will not reduce the average life.

HPS ballasts shall have a solid-state igniter/starter with an average life in the pulsing mode of 3500 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C.

2.3 POLES

Provide poles designed for wind loading of 100 miles per hour determined in accordance with AASHTO LTS3 while supporting luminaires having effective projected areas indicated. Poles shall be anchor-base type designed for use with underground supply conductors. Poles shall have oval-shaped handhole having a minimum clear opening of 2.5 by 5 inches. Handhole cover shall be secured by stainless steel captive screws.

2.3.1 Steel Poles

AASHTO LTS2. Provide steel poles having minimum wall thickness and yield/strength as indicated. Provide powder coat factory finish. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Base covers for steel poles shall be structural quality hot-rolled carbon steel plate having a minimum yield of 36,000 psi.

2.4 BRACKETS AND SUPPORTS

ANSI C136.3, ANSI C136.13, and ANSI C136.21, as applicable. Pole brackets shall be not less than 1 1/4 inch galvanized steel pipe secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to luminaires provided, and brackets for use with one type of luminaire shall be identical. Brackets for pole-mounted street lights shall correctly position luminaire no lower than mounting height indicated. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with luminaire head.

2.5 POLE FOUNDATIONS

Anchor bolts shall be steel rod having a minimum yield strength of 50,000 psi; the top 12 inches of the rod shall be galvanized in accordance with ASTM A 153/A 153M. Concrete shall be as specified in Section 03300, "Cast-In-Place Concrete."

PART 3 EXECUTION

3.1 INSTALLATION OF POLES

ANSI C2, NFPA 70, and to the requirements specified herein.

3.1.1 Steel

Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bttom end. Provide galvanized nuts, washers, and ornamental covers for anchor bolts. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location.

3.2 GROUNDING

Ground noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.3 FIELD QUALITY CONTROL

Upon completion of installation, conduct an operating test to show that the equipment operates in accordance with the requirements of this section.

-- End of Section --

SECTION 16751

CLOSED CIRCUIT TELEVISION SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 170	(1957) Electrical Performance Standards - Monochrome Television Studio Facilities
EIA ANSI/EIA-310-D	(1992) Racks, Panels, and Associated Equipment
EIA ANSI/EIA-375-A	(1974) Direct View Monochrome Closed Circuit Television Monitors 525/60 Interlaced 2:1
EIA ANSI/EIA/TIA-232-F	(2002) Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2005) National Electrical Safety Code
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 142	(1992) Recommended Practice for Grounding of Industrial and Commercial Power Systems - Green Book

1.2 SYSTEM DESCRIPTION

1.2.1 General

The Contractor shall configure the system as described and shown. All television equipment shall conform to EIA 170 specifications. The system shall include all connectors, adapters, and terminators necessary to interconnect all equipment. The Contractor shall also supply all cabling necessary to interconnect the closed circuit television (CCTV) equipment installed in the Security Center, and interconnect equipment installed at remote control/monitoring stations.

1.2.2 System Overall Reliability Requirement

The system, including all components and appurtenances, shall be configured and installed to yield a mean time between failure (MTBF) of at least

10,000 hours, and shall be calculated based on the configuration specified in paragraph "System Overall Reliability Calculations."

1.2.3 Power Line Surge Protection

All equipment connected to AC power shall be protected from surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41. Fuses shall not be used for surge protection.

1.2.4 Video and Sync Signal Transmission Line Surge Protection

All cable, except fiber optic cable, used for sync or video signal transmission shall include protective devices to safeguard the CCTV equipment against surges. The surge suppression device shall not attenuate or reduce the video or sync signal under normal conditions. The surge suppression device shall be capable of dissipating not less than 1500 watts for 1 millisecond, and the response time from zero volts to clamping shall not be greater than 5 nanoseconds. Fuses shall not be used for surge protection.

1.2.5 Control Line Surge Protection

All cables and conductors, except fiber optic cables, which serve as communication, control, or signal lines shall be protected against surges and shall have surge protection installed at each end. Protection shall be furnished at the equipment and additional triple electrode gas surge protectors rated for the application on each wireline circuit shall be installed within 3 feet of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode.

1.2.6 Power Line Conditioners

A power line conditioner shall be furnished for the security console CCTV equipment. The power line conditioner shall be of the ferroresonant design, with no moving parts and no tap switching, while electrically isolating the secondary from the power line side. The power line conditioner shall be sized for 125 percent of the actual connected kVA load. Characteristics of the power line conditioner shall be as follows:

a. At 85 percent load, the output voltage shall not deviate by more than plus or minus 1 percent of nominal when the input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.

b. During load changes of zero to full load, the output voltage shall not deviate by more than plus or minus 3 percent of nominal. Full correction of load switching disturbances shall be accomplished within 5 cycles, and 95 percent correction shall be accomplished within 2 cycles of the onset of the disturbance.

c. Total harmonic distortion shall not exceed 3-1/2 percent at full load.

1.2.7 Video and Control Signal Data Transmission Media

The Contractor shall provide a video and data and control signal transmission system.

1.2.8 Environmental Conditions

1.2.8.1 Field Equipment

The cameras and all other field equipment shall be rated for continuous operation under ambient environmental conditions of minus 10.0 degrees C to 55 degrees C using no auxiliary heating or cooling equipment. Equipment shall be rated for continuous operation under the ambient environmental temperature, humidity, wind loading, ice loading, and vibration conditions specified or encountered for the installed location.

1.2.8.2 Security Center Equipment

Security Center and remote control/monitoring station equipment shall, unless designated otherwise, be rated for continuous operation under ambient environmental conditions of 60 degrees F to 85 degrees F and a relative humidity of 20 to 80 percent.

1.2.9 Electrical Requirements

Electrically powered IDS equipment shall operate on 120 volt 60 Hz AC sources as shown. Equipment shall be able to tolerate variations in the voltage source of plus or minus 10 percent, and variations in the line frequency of plus or minus 2 percent with no degradation of performance.

1.3 Group I Technical Data Package

1.3.1 System Drawings

The data package shall include the following:

a. System block diagram.

b. CCTV system console installation, block diagrams, and wiring diagrams.

c. Security center CCTV equipment installation, interconnection with console equipment, block diagrams and wiring diagrams.

d. Remote control/monitoring station installation, interconnection to security center including block diagrams and wiring diagrams.

e. Camera wiring and installation drawings.

f. Pan/tilt mount wiring and installation drawings.

g. Interconnection with video signal transmission system, block diagrams and wiring diagrams.

h. Surge protection device installation.

1.3.2 Manufacturers' Data

The data package shall include manufacturers' data for all materials and equipment and security center equipment provided under this specification.

1.3.3 System Description and Analyses

The data package shall include complete system descriptions, analyses and

calculations used in sizing the equipment required by these specifications. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance of this specification. The data package shall include the following:

a. Switcher matrix size.

b. Camera call-up response time.

c. System start up and shutdown operations.

d. Switcher programming instructions.

e. Switcher operating and maintenance instructions.

f. Manuals for CCTV equipment.

g. Data entry forms.

1.3.4 Software Data

The data package shall consist of descriptions of the operation and capability of system and application software as specified.

1.3.5 Overall System Reliability Calculations

The data package shall include all manufacturer's reliability data and calculations required to show compliance with the specified reliability. The calculations shall be based on all CCTV equipment associated with one camera circuit and the console CCTV equipment, excluding the data transmission media (DTM).

1.4 Operation and Maintenance Data

Final copies of each of the manufacturer's commercial manuals arranged as specified bound in hardback, loose-leaf binders, shall be delivered to the Owner within 30 days after completing the endurance test. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each subContractor installing equipment and systems, and nearest service representatives for each item of equipment for each system. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include all modifications made during installation, checkout, and acceptance. The number of copies of each manual to be delivered shall be eight.

1.4.1 Functional Design Manual

The functional design manual shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes.

1.4.2 Hardware Manual

A manual shall describe all equipment furnished, including:

a. General hardware description and specifications.

b. Installation and checkout procedures.

c. Equipment electrical schematics and layout drawings.

d. System schematics and wiring lists.

e. System setup procedures.

f. Manufacturer's repair parts list.

g. Interface definition.

1.4.3 Software Manual

The software manual shall describe the functions of all software, and shall include all other information necessary to enable proper loading, testing and operation, including:

a. Definitions of terms and functions.

b. Procedures for system boot-up.

c. Description of using the programs.

d. Description of required operational sequences.

e. Directory of all disk files.

f. Description of all communications protocols, including data formats, command characters, and a sample of each type of data transfer.

1.4.4 Operator's Manual

The operator's manual shall explain all procedures and instructions for operation of the system including:

a. Video switcher.

b. Video multiplexer.

c. Cameras and video recording equipment.

d. Use of the software.

e. Operator commands.

f. System start-up and shut-down procedures.

g. Recovery and restart procedures.

1.4.5 Maintenance Manual

The maintenance manual shall describe maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

1.4.6 As-Built Drawings

The Contractor shall maintain a separate set of drawings, elementary diagrams and wiring diagrams of the CCTV system to be used for as-built drawings. This set shall be accurately kept up to date by the Contractor with all changes and additions to the CCTV system and shall be delivered to the Owner with the operation and maintance data. In addition to being complete and accurate, this set of drawings shall be kept neat and shall not be used for installation purposes.

1.5 TESTING

1.5.1 General

The Contractor shall perform predelivery testing, site testing, and adjustment of the completed CCTV system. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing. Written notification of planned testing shall be given to the Owner's Representative at least 14 days prior to the test.

1.6 TRAINING

1.6.1 General

The Contractor shall conduct training courses for designated personnel in the maintenance and operation of the CCTV system as specified. The training shall be oriented to the specific system being installed under this contract. Training manuals shall be delivered for each trainee with two additional manuals delivered for archiving at the project site. The manuals shall include an agenda, defined objectives for each lesson, and a detailed description of the subject matter for each lesson. The Contractor is responsible for furnishing all audio-visual equipment and all other training materials and supplies. Where the Contractor presents portions of the course through the use of audio-visual material, copies of the audio-visual materials shall be delivered to the Owner, either as a part of the printed training manuals or on the same media as that used during the training sessions. For guidance in planning the required instruction, the Contractor should assume the attendees will have a high school education or equivalent. Approval of the planned training schedule shall be obtained from the Owner's Representative at least 30 days prior to the training.

1.6.2 Operator's Training

The course shall be taught at the project site for four consecutive hours. A maximum of 12 personnel will attend the course. The course shall consist of classroom instruction, hands-on training, instruction on the specific hardware configuration of the installed system, and specific instructions for operating the installed system. The course shall demonstrate system start up, system operation, system shutdown, system recovery after a failure, the specific hardware configuration, and operation of the system and its software. The students should have no unanswered questions regarding operation of the installed CCTV system. The Contractor shall prepare and insert additional training material in the training manuals when the need for additional material becomes apparent during instruction. The Contractor shall prepare a written report after the completion of the course. The course shall include:

a. General CCTV hardware, installed system architecture and configuration.

b. Functional operation of the installed system and software.

c. Operator commands.

d. Alarm interfaces.

e. Alarm reporting.

f. Fault diagnostics and correction.

g. General system maintenance.

h. Replacement of failed components and integration of replacement components into the operating CCTV system.

1.7 MAINTENANCE AND SERVICE

1.7.1 General Requirements

The Contractor shall provide all services required and equipment necessary to maintain the entire CCTV system in an operational state as specified for a period of 1 year after completion, and shall provide all necessary material required for the work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other unscheduled work.

1.7.2 Description of Work

The adjustment and repair of the CCTV system includes all computer equipment, software updates, signal transmission equipment, and video equipment. Provide the manufacturer's required adjustments and all other work necessary.

1.7.3 Personnel

Service personnel shall be qualified to accomplish all work promptly and satisfactorily. The Owner shall be advised in writing of the name of the designated service representative, and of any changes in personnel.

1.7.4 Schedule of Work

The Contractor shall perform two inspections at 6-month intervals or less. This work shall be performed during regular working hours, Monday through Friday, excluding legal holidays. These inspections shall include:

a. Visual checks and operational tests of the CPU, switcher, peripheral equipment, interface panels, recording devices, monitors, video equipment electrical and mechanical controls, and a check of the picture quality from each camera.

b. Run system software and correct all diagnosed problems.

c. Resolve any previous outstanding problems.

1.7.5 Emergency Service

The Owner will initiate service calls when the CCTV system is not functioning properly. Qualified personnel shall be available to provide service to the complete CCTV system. The Owner shall be furnished with a

telephone number where the service supervisor can be reached at all times. Service personnel shall be at the site within 72 hours after receiving a request for service. The CCTV system shall be restored to proper operating condition within 5 calendar days after receiving a request for service.

1.7.6 Operation

Performance of scheduled adjustments and repair shall verify operation of the CCTV system as demonstrated by the applicable portions of the performance verification test.

1.7.7 Records and Logs

The Contractor shall keep records and logs of each task, and shall organize cumulative records for each major component, and for the complete system chronologically. A continuous log shall be maintained for all devices. The log shall contain calibration, repair, and programming data. Complete logs shall be kept and shall be available for inspection on site, demonstrating that planned and systematic adjustments and repairs have been accomplished for the CCTV system.

1.7.8 Work Requests

The Contractor shall separately record each service call request, as received. The form shall include the serial number identifying the component involved, its location, date and time the call was received, nature of trouble, names of the service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion. The Contractor shall deliver a record of the work performed within 5 days after work is completed.

1.7.9 System Modifications

The Contractor shall make any recommendations for system modification in writing to the Owner. No system modifications, including operating parameters and control settings, shall be made without prior approval of the Owner. Any modifications made to the systems shall be incorporated into the operations and maintenance manuals, and other documentation affected.

1.7.10 Software

The Contractor shall recommend all software updates to the Owner for approval. Upon Owner approval, updates shall be accomplished in a timely manner, fully coordinated with the CCTV system operators, operation in the system verified, and shall be incorporated into the operations and maintenance manuals, and software documentation. There shall be at least one scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the manufacturer's software.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

All system hardware and software components shall be produced by manufacturers regularly engaged in the production of CCTV equipment. Units of the same type of equipment shall be products of a single manufacturer.

All material and equipment shall be new and currently in production. Each major component of equipment shall have the manufacturer's name and address, and the model and serial number in a conspicuous place. Equipment located at the security center or a remote control/monitoring station shall be rack mounted.

2.1.1 Soldering

All soldering shall be done in accordance with standard industry practices.

2.2 SOLID STATE CAMERAS

2.2.1 High Resolution Color Camera

All electronic components and circuits shall be solid state. Signal-to-noise ratio shall not be less than 50 dB unweighted. The camera shall exhibit no geometric distortion. The lens mount shall be C/CS mount, and the camera shall have a back focus adjustment. The camera shall operate from 25 to 110 degrees F without auxiliary heating or cooling, and with no change in picture quality or resolution. The camera shall operate on 60 Hz AC power, and shall be capable of operating at a voltage of 105 to 130 Volts.

2.2.1.1 Solid State Image Array

The camera shall have a solid state imaging array, and the picture produced by the camera shall be free of blemishes as defined by EIA 330. The camera shall provide not less than 460 lines of horizontal resolution, and resolution shall not vary over the life of the camera. The imager shall have at least 768 horizontal x 494 vertical active picture elements.

2.2.1.2 Sensitivity

Camera shall provide full video output with the infrared cut-off filter installed, without camera automatic gain, and a scene reflectivity of 75 percent using an f/1.2 lens given a camera faceplate illumination of 0.3 footcandle minimum.

2.2.1.3 Camera Synchronization

The camera shall have an input for external sync, and shall automatically switch over to internal sync if external sync is not present. The camera shall also have the capability of synchronization by line-locking to the AC power line frequency at the zero crossing point, and shall provide not less than plus or minus 90 degrees of vertical phase adjustment.

2.2.1.4 Connectors

Cameras with lenses having auto iris, manual iris, or zoom and focus functions shall be supplied with connectors and wiring as needed to operate the lens functions. Video signal output connector shall be a BNC. Cameras with integral fiber optic video transmitters shall have straight-tip bayonet type fiber optic video output connectors. A connector shall be provided for external sync input.

2.2.1.5 Automatic Circuits

The camera shall have circuitry for through the lens (TTL) white balancing, fixed white balancing, and automatic gain control.

2.2.2 Dome Cameras

2.2.2.1 Interior Dome Camera System

An interior dome camera system shall be provided with integral camera installed and integrated into the dome housing. The camera shall meet the requirements of Paragraph: High Resolution Color Camera. The dome housing shall be nominally 6 inches and shall be furnished in a ceiling mount. The lower dome shall be tinted acrylic and shall have a light attenuation factor of not more that 1 f-stop. The housing shall be equipped with integral pan/tilt complete with wiring, wiring harnesses, connectors, receiver/driver, pan/tilt control system, pre-position cards, or any other hardware and equipment as needed to provide a fully functional pan/tilt dome. The pan/tilt shall have heavy duty bearings and hardened steel gears. The pan/tilt shall be permanently lubricated. The motors shall be thermally or impedance protected against overload damage. Pan movement shall be 360 degrees and tilt movement shall not be less than plus and minus 90 degrees. Pan speed shall not be less than 20 degrees per second, and tilt speed shall not be less than 10 degrees per second. There shall not be less than 64 preset positions, with positioning speeds of at least 360 degrees per second in the automatic mode, and not less than 120 degrees pre second in the manual positioning mode, with a positioning accuracy of plus or minus 1/2 degree. Each set of preset position data shall include auto focus, auto iris, pan, tilt, and zoom functions. The system shall be able to automatically scan between any two electronically-set limits, and shall be able to operate in the "tour" mode covering up to all presets in a user defined sequence. The dome system shall withstand temperature ranges from minus 10 to 50 degrees C over a humidity range of 0 to 90 percent, non-condensing.

2.2.2.2 Exterior Dome Camera System

An exterior dome camera system shall be provided with integral camera installed and integrated into the dome housing. The camera shall have a minimum horizontal resolution of 425 lines (color) or 500 lines. The dome housing shall be nominally 6 inches and shall be furnished in a NEMA 4 pendant mount, pole mount, ceiling mount, surface mount, or corner mount as necessary. The housing shall be constructed to be dust and water tight, and fully operational in 100 percent condensing humidity. The housing shall be equipped with supplementary camera mounting blocks or supports as needed to position the specified camera and lens to maintain the proper optical centerline. All electrical and signal connections required for operation of the camera and lens shall be supplied. The housing shall protect the internal drives, positioners, and camera from the environment encountered for camera operation. The lower dome shall be tinted acrylic and shall have a light attenuation factor of not more that 1 f-stop. An integral heater, sized to maintain the lower dome above the dew point, shall be part of the camera system. The housing shall be equipped with integral pan/tilt complete with wiring, wiring harnesses, connectors, receiver/driver, pan/tilt control system, pre-position cards, or any other hardware and equipment as needed to provide a fully functional pan/tilt dome. The pan/tilt shall have heavy duty bearings and hardened steel gears. The pan/tilt shall be permanently lubricated. The motors shall be thermally or impedance protected against overload damage. Pan movement shall be 360 degrees and tilt movement shall not be less than plus and minus 90 degrees. Pan speed shall not be less than 20 degrees per second, and tilt speed shall not be less than 10 degrees per second. There shall not be less than 99 preset positions, with positioning speeds of at least 360 degrees per

second in the automatic mode, and not less than 120 degrees pre second in the manual positioning mode, with a positioning accuracy of plus or minus 1/2 degree. Each set of preset position data shall include auto focus, auto iris, pan, tilt, and zoom functions. The system shall be able to automatically scan between any two electronically-set limits, and shall be able to operate in the "tour" mode covering up to all presets in a user defined sequence. The dome system shall withstand temperature ranges from minus 40 to 50 degrees C over a humidity range of 0 to 90 percent, non-condensing.

2.3 CAMERA LENSES

Camera lenses shall be all glass with coated optics. The lens mount shall be a C or CS mount, compatible with the cameras selected. The lens shall be supplied with the camera, and shall have a maximum f-stop opening of f/1.2 or the maximum available for the focal length specified. The lens shall be equipped with an auto-iris mechanism unless otherwise specified. Lenses having auto iris, manual iris, or zoom and focus functions shall be supplied with connectors, wiring, receiver/drivers, and controls as needed to operate the lens functions. Lenses shall have sufficient circle of illumination to cover the image sensor evenly. Lenses shall not be used on a camera with an image format larger than the lens is designed to cover. Lens focal lengths shall be as shown or specified in the manufacturer's lens selection tables.

2.4 CAMERA HOUSINGS AND MOUNTS

The camera and lens shall be enclosed in a tamper resistant housing as specified below. Any ancillary housing mounting hardware needed to install the housing at the camera location shall be provided as part of the housing. The camera and lens contained in a camera housing shall be installed on a camera support as shown. Any ancillary mounting hardware needed to install the support and to install the camera on the support shall be provided as part of the support. The camera support shall be capable of supporting the equipment to be mounted on it including wind and ice loading normally encountered at the site.

2.4.1 Environmentally Sealed Camera Housing

The housing shall be designed to provide a condensation free environment for camera operation. The housing shall be constructed to be dust and water tight, and fully operational in 100 percent condensing humidity. The housing shall be purged of atmospheric air and pressurized with dry nitrogen, shall be equipped with a fill valve, overpressure valve, and shall have a humidity indicator visible from the exterior. Housing shall not have a leak rate greater than 2 pounds per square inch at sea level within a 90 day period. The housing shall be equipped with supplementary camera mounting blocks or supports as needed to position the specified camera and lens to maintain the proper optical centerline. All electrical and signal connections required for operation of the camera and lens shall be supplied. The housing shall provide the environment needed for camera operation, and shall keep the viewing window free of fog, snow, and ice. The housing shall be equipped with a sunshield, and both the housing and the sunshield shall be white. A mounting bracket which can be adjusted to center the weight of the housing and camera assembly shall be provided as part of the housing.

2.4.2 Indoor Camera Housing

The housing shall be designed to provide a tamper resistant enclosure for indoor camera operation. The housing shall be equipped with tamper proof latches, and shall be supplied with the proper mounting brackets for the specified camera and lens. The housing and appurtenances shall be a color that does not conflict with the building interior color scheme.

2.4.3 Interior Mount

The camera mount shall be suitable for either wall or ceiling mounting and shall have an adjustable head for mounting the camera. The wall mount and head shall be constructed of aluminum or steel with a corrosion-resistant finish. The head shall be adjustable for 360 degrees of pan, and not less than 90 degrees of tilt.

2.4.4 Low Profile Ceiling Mount

A tamperproof ceiling housing shall be provided for the camera. The housing shall be low profile and shall be suitable for replacement of 2 by 2 foot ceiling tiles. The housing shall be equipped with a camera mounting bracket and shall allow a 360 degree viewing setup.

2.4.5 Interior Dome Housing

An interior dome housing shall be provided for each camera as shown. The dome housing shall be a pendant mount, pole mount, ceiling mount, surface mount, or corner mount as shown. The lower dome shall be black opaque acrylic and shall have a light attenuation factor of not more that 1 f-stop. The housing shall be equipped with integral pan/tilt complete with wiring, wiring harnesses, connectors, receiver/driver, pan/tilt control system, pre-position cards, or any other hardware and equipment as needed to provide a fully functional pan/tilt dome. The pan/tilt shall have heavy duty bearings and hardened steel gears. The pan/tilt shall be permanently lubricated. The motors shall be thermally or impedance protected against overload damage. Pan movement shall be 360 degrees and tilt movement shall not be less than plus and minus 90 degrees. Pan speed shall not be less than 20 degrees per second, and tilt speed shall not be less than 10 degrees per second.

2.4.6 Exterior Dome Housing

An exterior dome housing shall be provided for each camera as shown. The dome housing shall be a pendant mount, pole mount, ceiling mount, surface mount, or corner mount as shown. The housing shall be constructed to be dust and water tight, and fully operational in 100 percent condensing humidity. The housing shall be purged of atmospheric air and pressurized with dry nitrogen, shall be equipped with a fill valve and overpressure valve, and shall have a pressure indicator visible from the exterior. The housing shall be equipped with supplementary camera mounting blocks or supports as needed to position the specified camera and lens to maintain the proper optical centerline. All electrical and signal connections required for operation of the camera and lens shall be supplied. The housing shall provide the environment needed for camera operation The lower dome shall be black opaque acrylic and shall have a light attenuation factor of not more that 1 f-stop. The housing shall be equipped with integral pan/tilt complete with wiring, wiring harnesses, connectors, receiver/driver, pan/tilt control system, pre-position cards, or any other hardware and equipment as needed to provide a fully functional pan/tilt

dome. The pan/tilt shall have heavy duty bearings and hardened steel gears. The pan/tilt shall be permanently lubricated. The motors shall be thermally or impedance protected against overload damage. Pan movement shall be 360 degrees and tilt movement shall not be less than plus and minus 90 degrees. Pan speed shall not be less than 20 degrees per second, and tilt speed shall not be less than 10 degrees per second.

2.4.7 Exterior Wall Mount

The exterior camera wall mount shall be 16 24 inches long, and shall have an adjustable head for mounting the camera. The wall mount and head shall be constructed of aluminum, stainless steel, or steel with a corrosion-resistant finish. The head shall be adjustable for not less than plus and minus 90 degrees of pan, and not less than plus and minus 45 degrees of tilt. If the bracket is to be used in conjunction with a pan/tilt, the bracket shall be supplied without the adjustable mounting head, and shall have a bolt hole pattern to match the pan/tilt base.

2.5 VIDEO MONITOR

2.5.1 Color Video Monitor

All electronic components and circuits shall be solid state except for the picture tube. The monitor shall have a stabilized high voltage power supply, and regulated low voltage power supplies. The monitor shall have automatic frequency control (AFC) and horizontal resolution not less than 280 lines at the center of the picture tube. The video input shall allow switchable loop-through or 75 ohm termination. The monitor shall have circuitry for automatic degaussing. The monitor shall operate on 60 Hz AC power, and shall be capable of operating at a voltage of 105 to 130 Volts.

2.5.2 Picture Tube

The monitor shall have a 17 inch, minimum picture tube measured diagonally.

2.5.3 Configuration

The monitor shall be configured in a rack mount. The rack mount shall fit in a standard EIA 19 inch rack as described in EIA ANSI/EIA-310-D. Monitors shall not interfere with each other when rack mounted or operated next to each other as described in EIA ANSI/EIA-375-A.

2.5.4 Controls

Front panel controls shall be provided for power on/off, horizontal hold, vertical hold, contrast, and brightness. The monitor shall have switchable DC restoration.

2.5.5 Connectors for Video Monitor

Video signal input and output shall be by BNC connectors.

2.6 VIDEO SWITCHER

The switcher shall conform to EIA 170 specifications, and shall be a vertical interval switcher. Electronic components, subassemblies, and circuits of the switcher shall be solid state. The switcher shall be microprocessor based and software programmable. The switcher shall be a modular system that shall allow for expansion or modification of inputs,

outputs, alarm interfaces, and secondary control stations by addition of the appropriate modules. Switcher components shall operate on 120 volts 60 Hz AC power. The switcher central processor unit shall be capable of being interfaced to a master security computer for integrated operation and control. All components, modules, cables, power supplies, software, and other items needed for a complete and operable CCTV switching system shall be provided. Switcher equipment shall be rack mounted unless otherwise specified. Rack mount hardware shall be supplied to mount the switcher components in a standard 19 inch rack as described in EIA ANSI/EIA-310-D.

2.6.1 Switcher Software

The switcher shall be software programmable, and the software shall be supplied as part of the switcher. The software shall be installed in the switcher CPU, and shall be configured as required by the site design. Changes or alterations of features under software control shall be accomplished through software programming without changes in hardware or system configuration. The switcher shall retain the current program for at least 6 hours in the event of power loss, and shall not require reprogramming in order to restart the system.

2.6.2 Switcher Matrix

The switcher shall be a programmable crosspoint switcher capable of switching any video input to any video output. The switcher to be installed at the site shall be configured to switch all cameras to three monitors, and shall have an expansion capability of not less than four additional cameras.

2.6.3 Switcher Modular Expansion

The switcher shall be expandable in minimum increments as specified below.

2.6.3.1 Input Module

Hardware expansion modules shall be provided to expand the switcher matrix configuration in increments of at least 8 camera inputs.

2.6.3.2 Output Module

Hardware expansion modules shall be provided to expand the switcher matrix configuration in increments of at least 4 video outputs.

2.6.4 Alarm Interface

An alarm interface shall be furnished with the switcher. The alarm interface shall monitor alarm closures for processing by the switcher CPU. Alarm inputs to the alarm interface shall be relay contact or through an EIA ANSI/EIA/TIA-232-F interface. The alarm interface shall be modular and shall allow for system expansion. The alarm interface to be installed at the site shall be configured to handle four alarm points, and shall have an expansion capability of not less than 100 percent. An output shall be provided to actuate a video recorder.

2.6.5 Switcher Response Time and Alarm Processing

The switcher response time shall not be greater than 200 milliseconds from the time the alarm is sensed at the switcher alarm interface, until the picture is displayed on the monitor. The switcher shall continue to

process subsequent alarms and shall put them in a queue. The operator shall be able to view the alarms in queue by operating an alarm release function which switches the subsequent alarms to the monitor in the order of occurrence.

2.6.6 Control Keyboards

Control and programming keyboards shall be supplied for the video switcher at the security center, and control keyboards shall be supplied for any control/monitoring stations as shown. The control keyboard shall provide the interface between the operator and the CCTV system, and shall relay commands from the operator to the switcher CPU. The keyboard shall provide control of the video switcher functions needed for operation and programming of the video switcher. Controls shall include, but not be limited to: programming the switcher, switcher control, lens function control, pan/tilt/zoom (PTZ) control, control of environmental housing accessories, and annotation programming. If the switcher CPU requires an additional text keyboard for system management functions, the keyboard shall be supplied as part of the video switcher.

2.6.7 Accessory Control Equipment

The video switcher shall be equipped with signal distribution units, preposition cards, expansion units, cables, software or any other equipment needed to ensure that the CCTV system is complete and fully operational.

2.6.8 Connectors for Video Switcher

Video signal input and output shall be by BNC connectors.

2.6.9 Video Annotation

Video annotation equipment shall be provided for the video switcher. The annotation shall be alphanumeric and programmable for each video source. Annotation to be generated shall include, but not be limited to: individual video source identification number, time (hour, minute, second) in a 24 hour format, date (month, day, year), and a unique, user-defined title with at least 8 characters. The annotation shall be inserted onto the source video so that both shall appear on a monitor or recording. The lines of annotation shall be movable for horizontal and vertical placement on the video picture. The annotation shall be automatically adjusted for date. Programmed annotation information shall be retained in memory for at least 4 hours in the event of power loss.

2.7 VIDEO MULTIPLEXER

The video multiplexer shall be a multi-channel record and playback system with the capability of color real time multi-screen viewing. Electronic components, sub assemblies, and circuits of the multiplexer shall be solid state. The multiplexer, using time division multiplexing, shall permit up to 16 camera inputs to be recorded simultaneously on a single digital video recorder(DVR). All 16 camera inputs shall be capable of being viewed on a video monitor either live or recorded. The multiplexer shall allow for simultaneous viewing, recording playback, and multiplexing (Duplex Operation). The inputs shall be capable of simultaneous viewing on the monitor or full screen individually and in other multi-screen modes such as 2x2, 3x3, 4x4 or other configurations. The viewing format shall also permit 2x dynamic zoom capability, full screen. The multiplexer shall be compatible with EIA/NTSC video cameras and standard or super VHS VCRs.

External camera synchronization shall not be required for proper operation of the video multiplexer. Control of all functions of the multiplexer shall be provided either by a full function keyboard or by pushbutton selection with on-screen menu driven set-up. The multiplexer shall retain the current program for at east 6 hours in the event of power loss.

2.8 DIGITAL VIDEO RECORDER (DVR)

DVR shall conform to EIA 170 Standards. The DVR shall be specifically designed for use with this security system. The DVR shall operate on 120 volts 60 Hz AC power. Resolution of the DVR in normal play mode shall not be less than the resolution of the camera.

The DVR sha be 40W minimum and have internal hard drive capacity of 320GB. DVR shall operate with multiplex. The DVR shall comply with the following:

2.8.1 Video

Input: 1.0 Vp-p composite, 75ohm

Output: 1.0 Vp-p composite, 75 ohm

Colors: YUV 4:2:2. 16.8 million colors

Compression: Wavelet

2.8.2 Connectors

Connectors shall be RS-232, DB-9 male

I/O Port: DB-9, alarm input and output, record start in, alarm record reset, VEXT pulse out, error out, ground, video loss out, disk full output.

Video Inputs/Outputs: BNC, S-Video (4-pin mini)

SCSI-2: 50-pin male

Network: RJ45, 10/100 BaseT compatible

2.8.3 Remote Viewer Software Features

View live or recorded video

View archived video from disk array

Store video on PC's hard drive

Snapshots of live and recorded images

Review and search Video while recording

Password protection

2.8.4 CD Writer

Provide CD writer for CCTV system.

2.9 PERSONAL COMPUTER

Provide a computer with a Pentium 4 3GHX processor and 17 inch minimum monitor (32-bit min). Provide computer with sufficient hardware and software to operate CCTV System.

2.10 VIDEO SIGNAL EQUIPMENT

The following video signal equipment shall conform to EIA 170. Electrically powered equipment shall operate on 120 Volts 60 Hz AC power. All video signal inputs and outputs shall be by BNC connectors.

2.10.1 Ground Loop Corrector

The ground loop corrector shall eliminate the measured ground loop interference (common mode voltage) in wireline or coaxial video transmission lines. The ground loop corrector shall pass the full transmitted video bandwidth with no signal attenuation or loss. Clamping ground loop correctors shall be capable of rejecting at least an 8 volt peak-to-peak 60 Hz common mode signal. Ground isolation transformers shall be capable of rejecting at least a 10 volt peak-to-peak 60 Hz common mode signal. Ground isolation amplifiers shall be capable of rejecting at least a 30 volt peak-to-peak 60 Hz common mode signal. Differential ground loop correctors shall be capable of rejecting at least a 100 volt peak-to-peak 60 Hz common mode signal.

2.10.2 Video Loss/Presence Detector

The video loss/presence detector shall monitor video transmission lines for presence of the video signal. The detector shall annunciate an alarm when the video signal drops below a pre-set threshold level. A threshold level adjustment shall be provided for each video channel, and the threshold level shall be continuously adjustable through a lockable front panel control. A front panel reset control shall be provided for each video channel, which shall reset the detector after an alarm. The video loss alarm shall be annunciated through a front panel LED and a contact closure as a minimum. Video input shall be loop-through, and the video shall be unaffected when the detector is turned off. The detector shall not attenuate or reduce the level of the video signal passing through it.

2.10.3 Video Equalizing Amplifier

The video equalizing amplifier shall be designed to correct loss in video signal level and high frequency attenuation caused by long distance video signal transmission over wireline DTM. The amplifier shall have independent signal gain and equalization controls. The amplifier shall be capable of equalizing at least 3000 feet of RG-11/U coaxial cable conforming to paragraph CCTV Equipment Video Signal Wiring. The amplifier shall provide a minimum of plus or minus 6 dB of video gain and 12 dB of high frequency compensation. At least one video output shall be provided for each video input. Bandwidth shall be 10 MHz or greater, and frequency response to 8 MHz shall be plus or minus 1 dB or less. Hum and noise shall be 50 dB below 1 volt peak-to-peak or better. Video inputs shall be 75 ohm unbalanced, terminating, differential grounded. Video outputs shall be 75 ohm, differential, source terminated, 1 volt peak-to-peak. Output isolation shall be 40 dB or greater at 5 MHz.

2.10.4 Video Distribution Amplifier

The video distribution amplifier shall be designed to distribute a single, 75 ohm, unbalanced video input signal to a minimum of 75 ohm, source terminated video outputs. The distribution amplifier shall have not less than plus or minus 3 dB of gain adjustment for the video output. Output isolation shall be 40 dB or greater at 5 MHz. Bandwidth shall be 10 MHz or greater, and frequency response to 8 MHz shall be plus or minus 0.5 dB or less. Hum and noise shall be 55 dB below 1 volt peak-to-peak or better.

2.10.5 Master Video Sync Generator

The master video sync generator shall generate horizontal drive, vertical drive, blanking, and sync signals as a minimum, with at least one 75 ohm output provided for each signal. The master oscillator crystal shall be pre-aged, and temperature stabilized, ovenized or temperature compensated. The sync generator shall have a composite video input and shall lock to the incoming video signal. If no video is present at the video input, the sync generator shall switch to internal crystal control. Not less than 2.5 microseconds advance and 2.5 microseconds delay of horizontal phase shall be provided. Vertical blanking width adjustment shall be provided. Vertical blanking width adjustment shall have a minimum selection range of 19, 20, and 21 lines.

2.10.6 Video Sync Distribution Amplifier

The sync distribution amplifier shall be a regenerative amplifier designed to distribute a sync signal input to not less than 6, 75 ohm outputs. Output level shall remain constant and shall not be affected by input level variations. Output isolation shall be greater than 35 dB at 5 MHz. A high impedance loop through shall be provided in addition to the 6 outputs. The distribution amplifier shall have continuously variable delay range of at least 250 nanoseconds to 2.2 microseconds. The delay shall be adjustable through a front panel control.

2.11 ACCESSORIES

Standard 19 inch electronic rack cabinets conforming to EIA ANSI/EIA-310-D shall be provided for the CCTV system at the security center and remote control/monitoring sites as shown.

2.12 WIRE AND CABLE

The Contractor shall provide all wire and cable. All wire and cable components shall be able to withstand the environment the wire or cable is installed in for a minimum of 20 years.

2.12.1 CCTV Equipment Video Signal Wiring

The coaxial cable shall have a characteristic impedance of 75 ohms plus or minus 3 ohms. RG 59/U coaxial signal cable shall have shielding which provides a minimum of 95 percent coverage, a solid copper center conductor of not less than 23 AWG, polyethylene insulation, and a black non-contaminating polyvinylchloride (PVC) jacket. RG 6/U coaxial cable shall have shielding which provides a minimum of 95 percent coverage, with center conductor of 18 AWG or larger polyethylene insulation, and a black non-contaminating polyvinylchloride (PVC) jacket.

2.12.2 Low Voltage Control Wiring

Twisted pair low voltage control wiring to be used above ground or as direct burial cable shall be as recommended by manufacturer. Plenum or riser cables shall be IEEE C2 CL2P certified.

2.12.3 Digital Data Interconnection Wiring

Interconnecting cables carrying digital data between equipment located at the security center or at a secondary control/monitoring site shall be not less than 20 AWG and shall be stranded copper wire for each conductor. The cable or each individual conductor within the cable shall have a shield that provides 100 percent coverage. Cables with a single overall shield shall have a tinned copper shield drain wire. Plenum or riser cables shall be IEEE C2 CL2P certified.

2.13 PREDELIVERY TESTING

2.13.1 General

The Contractor shall assemble the test CCTV system as specified, and perform tests to demonstrate that the performance of the system complies with the contract requirements in accordance with the approved predelivery test procedures. The tests shall take place during regular daytime working hours on weekdays. Model numbers of equipment tested shall be identical to those to be delivered to the site.

2.13.2 Test Setup

The Contractor shall provide the equipment needed for the test setup and shall configure it to provide alarm actuated camera call-up and alarm recording as required to emulate the installed system. The test setup shall consist of at least 4 complete camera circuits. The alarm signal input to the CCTV test setup shall be by the same method that is used in the installed system. The video switcher shall be capable of switching any camera to any monitor and any combination of cameras to any combination of monitors. The minimum test setup shall include:

a. One video cameras and lenses, including dome cameras if required for the installed system.

b. Three video monitors.

c. Digital video recorder.

d. Video switcher including video input modules, video output modules, and control and applications software.

e. Video multiplexer.

f. Alarm input panel.

g. Any ancillary equipment associated with a camera circuit such as equalizing amplifiers, video loss/presence detectors, terminators, ground loop correctors, surge protectors or other in-line video devices.

h. Cabling for all components.

PART 3 EXECUTION

3.1 INSTALLATION

The Contractor shall install all system components including Owner furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2 and as shown, and shall furnish all necessary connectors, terminators, interconnections, services, and adjustments required for a complete and operable system. Raceways shall be furnished and installed as specified in Section 16402 INTERIOR DISTRIBUTION SYSTEM. DTM shall not be pulled into conduits or placed in raceways, compartments, outlet boxes, junction boxes, or similar fittings with other building wiring. All other electrical work shall be as specified in the above sections including grounding to preclude ground loops, noise, and surges from adversely affecting system operation.

3.1.1 Current Site Conditions

The Contractor shall visit the site and verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Owner. The Contractor shall not take any corrective action without written permission from the Owner.

3.1.2 Cold Galvanizing

All field welds and brazing on factory galvanized boxes, enclosures, and conduits shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.1.3 Interconnection of Console Video Equipment

The Contractor shall connect signal paths between video equipment with RG-6/U coaxial cable. Cables shall be as short as practicable for each signal path without causing strain at the connectors. Rack mounted equipment on slide mounts shall have cables of sufficient length to allow full extension of the slide rails from the rack.

3.1.4 Cameras

The Contractor shall install the cameras with the proper focal length lens for each zone; connect power and signal lines to the camera; set cameras with fixed iris lenses to the proper f-stop to give full video level; aim camera to give field of view as needed to cover the alarm zone; aim fixed mount cameras installed outdoors facing the rising or setting sun sufficiently below the horizon to preclude the camera looking directly at the sun; focus the lens to give a sharp picture over the entire field of view; and synchronize all cameras so the picture does not roll on the monitor when cameras are selected. Dome cameras shall have all preset positions defined and installed.

3.1.5 Monitors

The Contractor shall install the monitors as shown and specified; connect all signal inputs and outputs; terminate video input signals as required; and connect the monitor to AC power.

3.1.6 Switcher

The Contractor shall install the switcher as shown and according to manufacturer's instructions; connect all subassemblies as specified by the manufacturer; connect video signal inputs and outputs as shown and specified; terminate video inputs as required; connect alarm signal inputs and outputs; connect control signal inputs and outputs for ancillary equipment or secondary control/monitoring sites as specified by the manufacturer; connect the switcher CPU and switcher subassemblies to AC power; load all software as specified and required for an operational CCTV system configured for the site requirements, including data bases, operational parameters, and system, command, and application programs; provide the original and 2 backup copies for all accepted software upon successful completion of the endurance test; and program the video annotation for each camera.

3.1.7 Video Recording Equipment

The Contractor shall install the video recording equipment as specified by the manufacturer; connect video signal inputs and outputs; connect alarm signal inputs and outputs; and connect video recording equipment to AC power.

3.1.8 Video Signal Equipment

The Contractor shall install the video signal equipment as specified by the manufacturer; connect video or signal inputs and outputs; terminate video inputs as required; connect alarm signal inputs and outputs as required; connect control signal inputs and outputs as required; and connect electrically powered equipment to AC power.

3.1.9 Camera Housings, Mounts, and Poles

The Contractor shall install the camera housings and mounts as specified by the manufacturer and as shown, provide mounting hardware sized appropriately to secure each camera, housing and mount with maximum wind and ice loading encountered at the site; provide a foundation for each camera pole as specified and shown; provide a ground rod for each camera pole and connect the camera pole to the ground rod; provide electrical and signal transmission cabling to the mount location; connect signal lines and AC power to mount interfaces; and connect pole wiring harness to camera.

3.2 SYSTEM STARTUP

The Contractor shall not apply power to the CCTV system until the following items have been completed:

a. CCTV system equipment items and DTM have been set up in accordance with manufacturer's instructions.

b. A visual inspection of the CCTV system has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

c. System wiring has been tested and verified as correctly connected.

d. All system grounding and transient protection systems have been verified as properly installed and connected as indicated.

e. Power supplies to be connected to the CCTV system have been verified as the correct voltage, phasing, and frequency as indicated.

f. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.3 SITE TESTING

3.3.1 General

The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all site testing.

3.3.2 Contractor's Field Testing

The Contractor shall calibrate and test all equipment, verify DTM operation, place the integrated system in service, and test the integrated system. Ground rods installed by the Contractor shall be tested as specified in IEEE Std 142. Note any objects in the field of view that might produce highlights that could cause camera blinding. Note any objects in the field of view or anomalies in the terrain which may cause blind spots. Note if a camera cannot be aimed to cover the zone and exclude the rising or setting sun from the picture. Note night assessment capabilities and whether lights or vehicle headlights cause blooming or picture degradation. If any of the above conditions or other conditions exist that cause picture degradation or interfere with the camera field of view, the Contractor shall inform the Owner's Representative. The field testing shall as a minimum include:

a. Verification that the video transmission system and any signal or control cabling have been installed, tested, and approved as specified.

b. When the system includes remote control/monitoring stations or remote switch panels, verification that the remote devices are functional, communicate with the security center, and perform all functions as specified.

c. Verification that the switcher is fully functional and that the switcher software has been programmed as needed for the site configuration.

d. Verification that switcher software is functioning correctly. All software functions shall be exercised.

e. Verification that video multiplexers are functioning correctly.

f. Operation of all electrical and mechanical switcher controls and verification that the control performs the designed function.

g. Verification that all video sources and video outputs provide a full bandwidth signal that complies with EIA 170 at all video inputs.

h. Verification that all video signals are terminated properly.

i. Verification that all cameras are aimed and focused properly. The Contractor shall conduct a walk test of the area covered by each camera to verify the field of view.

j. Verification that cameras facing the direction of rising or setting sun are aimed sufficiently below the horizon so that the camera does not view the sun directly.

k. If vehicles are used in proximity of the assessment areas, verification of night assessment capabilities and determination if headlights cause blooming or picture degradation.

l. Verification that all cameras are synchronized and that the picture does not roll when cameras are switched.

m. When pan/tilt mounts are used in the system, verification that the limit stops have been set correctly. Verification of all controls for pan/tilt or zoom mechanisms are operative and that the controls perform the desired function. If preposition controls are used, verification that all home positions have been set correctly, and have been tested for auto home function and correct home position.

n. When dome camera mounts are used in the system, verify that all preset positions are correct and that the dome also operates correctly in a manual control mode.

3.3.3 Performance Verification Test

The Contractor shall demonstrate that the completed CCTV system complies with the contract requirements. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The Owner may terminate testing at any time when the system fails to perform as specified.

-- End of Section --

APPENDIX A

Ground Heat Exchanger (GHX) Inspection And Test Report (Form 1)

Note: Use a separate form for each system.

Building: Inspection Date:

Ground Heat Exchanger No. or Description:

List the GSHP Unit Nos. served by this GHX:

Ground Heat Exchanger Design Water Flow: gal/min

Calculated purging flow and press to achieve 2 ft/sec:

Purging: Flow: gal/min Head: psi Duration: min.

Did the system pass the pressure test? ☐ yes ☐ no

How much did -inch diameter reservoir level reservoir level change with ΔP? inches

Is antifreeze required in system? ☐ yes ☐ no If yes, was antifreeze measured? ☐ yes ☐ no

Has a dimensioned drawing been prepared, completely and accurately showing the layout of the GHX? ☐ yes ☐ no

Does the layout differ substantially from the contract documents? ☐ yes ☐ no
If so, is the deviation approved? ☐ yes ☐ no

Depth of installed vertical loops is ft. (Design is ft.)

Depth of horizontal piping is ft. (Design is ft.)

Are the trenches clear of sharp bends, rocks, or other sharp objects that could restrict the flow? ☐ yes ☐ no

Are all the joints heat fused (butt-, socket-, or saddle-fusion)? ☐ yes ☐ no
Do all the joints have the proper amount of roll-out? ☐ yes ☐ no

Has the piping material been cut out and properly removed from all saddle-fusion tees? ☐ yes ☐ no

Was the system backfilled properly with good, clean backfill materials? ☐ yes ☐ no

Comments:

Inspected and approved this _____(date)

By: Title:

APPENDIX B

Report of Subsurface Exploration
and Geotechnical Engineering Evaluation
New Kent County Rest Area
New Kent County, Virginia
F&R Project No. H60-0174G

Prepared For:

DJG, Inc.
449 McLaws Circle
Williamsburg, Virginia 23185

Attention: Mr. Daniel J. DeYoung, P.E.

By:
Froehling & Robertson, Inc.
3015 Dumbarton Road
Richmond, Virginia 23228

June 2006

SINCE
1881

FROEHLING & ROBERTSON, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS
ENGINEERS • LABORATORIES
"OVER ONE HUNDRED YEARS OF SERVICE"
3015 DUMBARTON ROAD • RICHMOND, VIRGINIA 23228
PHONE (804) 264-2701 • FAX (804) 264-7862
Web Site: www.FandR.com

F&R Project No.: H60-0174G

June 23, 2006

DJG, Inc.
449 McLaws Circle
Williamsburg, Virginia 23185

Attention: Mr. Daniel J. DeYoung, P.E.

Reference: New Kent County Rest Area (I-64 WBL)
New Kent County, Virginia

Dear Mr. DeYoung:

The purpose of this report is to present the results of the subsurface exploration program and geotechnical engineering analyses undertaken by Froehling & Robertson, Inc. (F&R) in connection with the above referenced project. Our services were performed in general accordance with our Proposal No. 0760-025G dated May 8, 2006. The attached report presents our understanding of the project, reviews our exploration procedures, describes existing site and general subsurface conditions, and presents our evaluations, conclusions, and recommendations.

We have enjoyed working with you on this project, and we are prepared to assist you with the recommended quality assurance monitoring and testing services during construction. Please contact us if you have any questions regarding this report or if we may be of further service.

Sincerely,
FROEHLING & ROBERTSON, INC.

Anna M. Kotas, E.I.T.
Geotechnical Engineering Staff

Richard S. Farmer, P.E.
Geotechnical Engineer

COMMONWEALTH OF VIRGINIA
RICHARD S. FARMER
Lic. No.
19366
PROFESSIONAL ENGINEER

Distribution: Addressee (3 copies)

F:\PROJECTS H60\H60-0174G (DGI-New Kent Rest Area\H60-0174G (DJG-New Kent REst Area).doc

TABLE OF CONTENTS

SECTION **PAGE**

1.0 INTRODUCTION 1

1.1 PROJECT INFORMATION 1
1.2 SCOPE OF SERVICES 1

2.0 SUBSURFACE EXPLORATION PROCEDURES 2

3.0 SITE AND SUBSURFACE CONDITIONS 3

3.1 SITE DESCRIPTION 3
3.2 REGIONAL GEOLOGY 3
3.3 SUBSURFACE CONDITIONS 4
3.3.1 General 4
3.3.2 Surficial Soils 4
3.3.3 Fill Soils 4
3.3.4 Alluvial Soils 4
3.3.5 Subsurface Water 5
3.4 LABORATORY TESTING 5

4.0 DESIGN RECOMMENDATIONS 7

4.1 GENERAL 7
4.2 FOUNDATION DESIGN 7
4.3 ESTIMATED SETTLEMENT 7
4.4 GROUND FLOOR SLABS 8
4.5 SEISMIC SITE CLASSIFICATION 8
4.6 PAVEMENTS 9
4.7 UNDERGROUND STORAGE TANK 11

5.0 CONSTRUCTION RECOMMENDATIONS 11

5.1 SITE PREPARATION 11
5.2 FOUNDATION CONSTRUCTION 12
5.3 CONTROLLED STRUCTURAL FILL 12
5.4 TANK EXCAVATION RECOMMENDATIONS 13
5.5 SUBSURFACE WATER CONDITIONS 13

6.0 CONTINUATION OF SERVICES 14

7.0 LIMITATIONS 15

APPENDICES

APPENDIX A

ASFE Information about Geotechnical Reports
Site Vicinity Map (Drawing No. 1)

APPENDIX B

Classification of Soils for Engineering Purposes
Key to Boring Log Soil Classification
Boring Location Plan (Drawing No. 2)
Boring Logs (B-1 through B-5, P-1, and P-2)

1.0 INTRODUCTION

1.1 Project Information

Project information was provided in various correspondences with Dan DeYoung, P.E. and Mr. Matt Burton of DJG, Inc and included an electronic copy of the layout plan of the proposed construction. We understand that improvements (including new building and paved areas) will be made to the existing New Kent County rest area located on the west bound side of I-64 between mile markers 211 and 214 in New Kent County, Virginia (see Site Vicinity Map, Drawing No. 1, Appendix A).

It is our understanding that the project will consist of the construction of a new Rest Area Building and some reconfigured asphalt drives. The new building will be single-story, approximately 11,000 square feet in size, and is anticipated to be located about 50 to 100 feet west of the existing Rest Area building. The existing building will be torn down. We understand that an underground water tank will be installed to the west of the proposed building. Heating for the new building will be provided via geothermal sources. A bio-retention pond area has been proposed within the triangular landscaped area at the east end of the site. Detailed information has not been provided; however, based on our experience with similar projects, we have assumed maximum column loads on the order of 50 kips and maximum wall loads of 2 to 3 kips/foot.

The finished floor elevation of the proposed building has not been provided; however, it appears that grades in the northwest corner of the proposed building will need to be raised by as much as 5 feet to establish the proposed building pad elevation.

1.2 Scope of Services

The purposes of our involvement on this project were as follows: 1) provide general descriptions of the subsurface soil conditions encountered at the boring locations, 2) provide foundation and pavement design recommendations, and 3) comment on geotechnical aspects of the proposed development. In order to accomplish the above objectives, we undertook the following scope of services:

1. Visited the site to observe existing surface conditions and features and to mark boring locations.
2. Coordinated with Miss Utility services for utility clearance.
3. Reviewed readily available geologic and subsurface information relative to the project site.

4. Executed a geotechnical subsurface exploration program consisting of seven (7) Standard Penetration Test borings each drilled to a depth ranging from 10 to 60 feet below existing site grades and performed percolation testing within the proposed bio-retention area.

5. Evaluated the findings of the test boring data relative to suitable shallow foundation systems and pavements and provided appropriate design criteria.

6. Provided a Seismic Site Class Definition per the 2003 International Building Code (IBC) based on interpretation of limited Standard Penetration Test data.

7. Prepared this written report summarizing our geotechnical engineering work on the project, providing descriptions of the subsurface conditions encountered, providing foundation and pavement design criteria, and discussing geotechnical related aspects of the proposed construction.

Our geotechnical scope of services did not include a survey of boring locations and elevations, rock coring, quantity estimates, preparation of plans or specifications, detention pond considerations, or the identification and evaluation of wetland and/or other environmental aspects of the project site.

2.0 SUBSURFACE EXPLORATION PROCEDURES

Our geotechnical subsurface exploration program consisted of seven test borings designated B-1 through B-5 for the building and underground water tank borings and P-1 and P-2 for the paved areas. The exploration was performed between June 12 and 16, 2006 at the approximate locations shown on the attached Boring Location Plan (Drawing No. 2, Appendix B). F&R personnel marked the boring locations in the field by measuring distances from existing features indicated on the provided plan by DJG, Inc. No claim is made as to the accuracy of the information contained in the provided documents. In consideration of the methods used in their determination, the boring locations shown on the attached Boring Location Plan should be considered approximate.

The test borings were performed in accordance with generally accepted practice using a truck-mounted CME-55 rotary drill rig. Hollow-stem augers were advanced to pre-selected depths, the center plug was removed, and representative soil samples were recovered with a standard split-spoon sampler (1 3/8 in. ID, 2 in. OD) in general accordance with ASTM D 1586, the Standard Penetration Test. The split-spoon sampler was driven into the soil by freely dropping a weight of 140 pounds from a height of 30 inches. The number of blows required to drive the split-spoon sampler three consecutive 6-inch increments is recorded, and the blows of the last two

increments are summed to obtain the Standard Penetration Resistance (N-value). The N-value provides a general indication of in-situ soil conditions and has been correlated with certain engineering properties of soils.

The test borings were advanced through the soil overburden to planned termination depths of 10 to 60 feet below the existing site grades. Subsurface water level readings were taken in each of the test borings immediately upon completion of the drilling process. Upon completion of drilling, the boreholes were backfilled with auger cuttings (soil). Periodic observation and maintenance of the boreholes should be performed to monitor for subsidence at the ground surface, as the borehole backfill could settle over time.

Each split-spoon soil sample was visually classified on the basis of texture and plasticity in general accordance with the Unified Soil Classification System (USCS) and/or ASTM D 2487. The group symbols for each soil type, based on the USCS, are indicated in the parentheses following the soil description on the boring logs. The geotechnical engineer grouped the various soil types into zones noted on the boring log. The stratification lines designating the interfaces between earth materials on the boring log are approximate; in situ, the transitions may be gradual.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Description

The project site is located on the west bound side of I-64 between mile markers 211 and 214 in New Kent County. The site currently consists of an existing rest area with the majority of the site landscaped or paved for vehicular and truck parking. The site grades range from an elevation of approximately El. 65 feet on the east property end to El. 90 within the west end of the property. Woods border the north side of the rest area while I-64 borders its southern limits.

3.2 Regional Geology

The project site lies within the central portion of the Coastal Plain Physiographic Province of Virginia. The Coastal Plain is characterized by bands of alluvial and marine sediments generally paralleling the coast. These sediment deposits, generally comprised of sands, silts and clays were deposited by advancing and retreating ocean shorelines through the Cenozoic eras. The soil deposits encountered on this site were deposited during the Pliocene period. The soil deposits consist of silty sand and appear to be part of the Bacons Castle Formation.

3.3 Subsurface Conditions

3.3.1 General

The subsurface conditions discussed in the following paragraphs and those shown on the attached boring logs represent an estimate of the subsurface conditions based on interpretation of the boring data using normally accepted geotechnical engineering judgments. The transitions between different soil strata are usually less distinct than those shown on the boring logs. Sometimes the relatively small sample obtained in the field is insufficient to definitively describe the origin of the subsurface material. In these cases, we qualify our origin descriptions with "possible" before the word describing the material's origin (i.e. possible fill, possible residuum, etc.). Although individual test borings are representative of the subsurface conditions at the boring locations on the dates shown, they are not necessarily indicative of subsurface conditions at other locations or at other times. Data from the specific test borings are shown on the attached boring logs in Appendix B.

3.3.2 Surficial Soils

Surficial soils typically contain root mat and/or other fibrous organic matter and are generally not suitable to engineering purposes. Surficial soils were encountered in all of the borings to depths ranging from 0.3 to 0.6 feet.

3.3.3 Fill Soils

Fill may be any material that has been transported and deposited by man. Materials described as fill were encountered only in boring B-5 to a depth of about 1.5 feet below existing site grades. Sampled fill materials were generally described as Silty SAND (SM). Standard penetration resistances (N-values) obtained within the sampled fill indicated 16 blows per foot (bpf), which classifies the sandy fill as medium dense.

3.3.4 Alluvial Soils

Underlying the surficial soils or fill, the borings encountered alluvial soils to the assigned termination depths. Sampled natural soils consisted of Sandy CLAY (CL), Clayey SAND (SC), Silty SAND (SM) or a combination of Clayey and Silty SAND (SC-SM). Standard penetration resistances (N-values) in the sampled alluvial soils ranged from 2 to 59 blows per foot (bpf) indicating that the clayey soils have a soft to very stiff consistency and the sandy soils are very loose to very dense.

3.3.5 Subsurface Water

The test borings were monitored during drilling, upon completion of drilling operations, and at the end of the work day to obtain short-term subsurface water information. The subsurface water data, obtained during and after our subsurface exploration, has been summarized in the following table. Specific water data may be found on individual boring logs. The boring elevations were estimated from the provided plans.

Boring Location	Depth of Boring (Feet)	Boring Elevation (Feet)	Groundwater Depth While Drilling (Feet)	Groundwater Depth at End of Day (Feet)	Cave-in Depth at End of Day (Feet)
B-1	30	74	22	21	21.5
B-2	30	76	23	Not Observed	22.5
B-3	30	84	27	Not Observed	24.5
B-4	60	80	Not Reported*	Not Reported*	Not Reported*
B-5	30	75	Not Reported*	Not Reported*	27.3
P-1	10	80	Not Reported*	Not Reported*	8.4
P-2	10	80	Not Reported*	Not Reported*	8.4

**Mud rotary drilling techniques injected water into the bore hole, thus distorting subsurface water information.*

It should be noted that the location of the groundwater table could vary by several feet because of seasonal fluctuations in precipitation, evaporation, surface water runoff, local topography, and other factors not immediately apparent at the time of this exploration. Normally, the highest groundwater levels occur in the late winter and spring and lowest levels occur in the late summer and fall. **It should be noted that borehole cave-in often indicates wet and unstable conditions.**

3.4 Laboratory testing

Representative soil samples were subjected to moisture content, # 200 wash testing, and Atterberg Limits testing in order to substantiate the visual classifications. Laboratory classification test results are provided on the following page. Classification procedures are further explained in Appendix B.

Boring No.	Sample Depth (Feet)	LL/ PI	Natural Moisture Content (%)	#200 Sieve	USCS Class.
B-2	3.5-5	-	48.6	44.2	SC
B-4	6-7.5	NP	19.3	14.9	SM

As part of this project, percolation testing was conducted in three undisturbed locations (Perc-1, Perc-2, and Perc-3) within the proposed bio-retention area at the east end of the site. The

percolation testing was performed in accordance with a standard method as outlined by David Gustafson and Roger Machmeier of the University of Minnesota. Results of the percolation testing are indicated in the following.

Location: Perc-1 Depth: 1 foot 10 inches	Elapsed Time (minutes)	Drop in Water Level (inches)	Percolation Rate (MPI – minutes per inch)
Test #1	39	6.25	6.24
Test #2	40	6	6.67
Test #3	36	5.5	6.54
		Average of three tests:	6.5 MPI

Location: Perc-2 Depth: 1 foot 10 inches	Elapsed Time (minutes)	Drop in Water Level (inches)	Percolation Rate (MPI – minutes per inch)
Test #1	41	9.25	4.43
Test #2	38	9	4.22
Test #3	37	9	4.11
		Average of three tests:	4.2 MPI

Location: Perc-3 Depth: 1 foot 10 inches	Elapsed Time (minutes)	Drop in Water Level (inches)	Percolation Rate (MPI – minutes per inch)
Test #1	42	9.25	4.54
Test #2	38	8.5	4.47
Test #3	37	8.5	4.35
		Average of three tests:	4.4 MPI

4.0 DESIGN RECOMMENDATIONS

4.1 General

The following evaluations and recommendations are based on our observations at the site, interpretation of the field data obtained during this exploration, and our experience with similar subsurface conditions and projects. Soil penetration data have been used to estimate an allowable bearing pressure and associated settlement using established correlations. Subsurface conditions in unexplored locations may vary from those encountered. If structure locations, loadings, or elevations are changed, we request that we be advised so that we may re-evaluate our recommendations.

Determination of an appropriate foundation system for a given structure is dependent on the proposed structural loads, soil conditions, and construction constraints such as proximity to other structures, etc. The subsurface exploration aids the geotechnical engineer in determining the soil stratum appropriate for structural support. This determination includes considerations with regard to both allowable bearing capacity and compressibility of the soil strata. In addition, since the method of construction greatly affects the soils intended for structural support, consideration must be given to the implementation of suitable methods of site preparation, fill compaction, and other aspects of construction.

4.2 Foundation Design

The proposed building may be supported on a shallow foundation system bearing on natural soil or controlled structural fill (see Section 5.3, Controlled Structural Fill recommendations) subgrades. All existing fill, abandoned foundations, and associated debris must be removed from the building footprint. Based on the subsurface conditions encountered, we recommend that foundations be designed for a maximum allowable bearing pressure of 2,000 pounds per square foot (psf) for footings bearing on approved subgrades.

To reduce the possibility of localized shear failures, spread and strip footings should be a minimum of 3 feet and 2 feet wide, respectively. We recommend that exterior footings be constructed at least 2 feet below adjacent grades in order to bear below the normal frost depth.

4.3 Estimated Settlement

Based on the boring data, we estimate settlements due to the anticipated building loads of less than 1 inch, with differential settlements of ½ to ⅔ the estimated total settlement. The magnitude of differential settlements will be influenced by the variation in excavation requirements across

the building footprint, the distribution of loads, the quality of the controlled structural fill, and the variability of underlying soils.

Our settlement analysis was performed on the basis of structural and grading assumptions discussed in the project information section of this report. Actual settlements experienced by the structure and the time required for these soils to settle will be influenced by undetected variations in subsurface conditions, actual structural loads, final grading plans, and the quality of fill placement and foundation construction.

4.4 Ground Floor Slabs

The ground floor slab may be designed as a slab-on-grade supported by approved natural soils or newly-placed controlled fill. Slab-on-grade support is contingent upon successful completion of the subgrade evaluation process as described in the Site Preparation section of this report. A vapor barrier should be used beneath ground floor slabs that will be covered by tile, wood, carpet, impermeable floor coatings, and/or if other moisture-sensitive equipment or materials will be in contact with the floor. However, the use of vapor barriers may result in excessive curling of floor slabs during curing. We refer the floor slab designer to ACI 302.1R-96, Sections 4.1.5 and 11.11, for further discussion on vapor barriers, curling, and the means to minimize concrete shrinkage and curling.

Proper jointing of the ground floor slab is also essential to minimize cracking. ACI suggests that unreinforced, plain concrete slabs may be jointed at spacings of 24 to 36 times the slab thickness, up to a maximum spacing of 18 feet. Floor slab construction should incorporate isolation joints along bearing walls and around column locations to allow minor movements to occur without damage. Utility or other construction excavations in the prepared floor subgrade should be backfilled to a controlled fill criterion to provide uniform floor support.

4.5 Seismic Site Classification

The following Seismic Site Class Definition was established per Section 1615.1.1 of the 2003 International Building Code (IBC). Our scope of services did not include a seismic conditions survey to determine site-specific shear wave velocity information. IBC 2003 provides a methodology for interpretation of Standard Penetration Test resistance values (N-values) to determine a Site Class Definition. However, this method requires averaging N-values over the top 100 feet of the subsurface profile. We note that the test borings for this project were extended to a maximum depth of 60 feet below existing site grades in order to characterize soils within the zone of influence for anticipated new structural loads.

The available subsurface data from our exploration indicates a typical N-value range of about 2 to 59 bpf within the upper 60 feet below existing site grades. We do not have definitive data to confirm penetration resistances below 60 feet or the presence of rock at depth. Section 1615.1.1 of the IBC 2003 states that *"When the soil properties are not known in sufficient detail to determine the site class, Site Class D shall be used unless the building official determines that Site Class E or F is likely to be present."* Therefore, and in general accordance with Section 1615.1.1 of the 2003 IBC, a **Site Classification "D"** should be used for further evaluations relative to Earthquake Load design.

We note that the above provided Site Classification is based on information available at the time this report was written. Should this classification be so onerous to the project cost that further study is warranted, we can perform deeper subsurface exploratory test borings and/or a site-specific geo-physical survey to attain sufficient detail to refine the project's Seismic Site Class Definition. This additional testing would be beyond the currently authorized scope of services for this project.

4.6 Pavements

Pavement subgrades should be prepared as discussed in this report. Dense-graded aggregate placed as pavement base course should be compacted to 98% of ASTM D 698 or 95% of ASTM D 1557.

Based on the results of our soil test borings, it appears that, in general, the soils that will be exposed as pavement subgrades will consist of Silty SAND (SM). Based on our experience in this geographic region and laboratory CBR values, we recommend using a design CBR value of 4 when the top one foot of subgrade has been compacted to at least 98% of the maximum dry density by the Standard Proctor test (ASTM D 698) or 95% by the Modified Proctor test (ASTM D 1557).

Based on the anticipated soil types, as well as the anticipated traffic flows, the following standard duty asphalt pavement section is recommended. The recommended section is not applicable for loading docks, heavy trafficked areas, and/or dumpster pads.

Standard Duty Asphalt Pavement Section Parking Spaces	
Asphalt Surface	Minimum 3 inches Asphalt Surface Material, Type SM-9.5A
Aggregate Base	8 inches Aggregate Base Material, Type I, Size 21B, or a "crushed concrete" base material that satisfies VDOT specifications, compacted to 98% of ASTM D 698 or 95% of ASTM D 1557

Heavy Duty Asphalt Pavement Section Access Drives and Maneuvering/Loading Areas	
Asphalt Surface	Minimum 2 inches Asphalt Surface Material, Type SM-9.5A
Asphalt Intermediate	Minimum 3 inches Asphalt Intermediate Material, Type IM-19.0
Aggregate Base	10 inches Aggregate Base Material, Type I, Size 21B, or a "crushed concrete" base material that satisfies VDOT specifications compacted to 98% of ASTM D 698 or 95% of ASTM D 1557

The final pavement area subgrade (natural soils or engineered fill) should be carefully evaluated by the geotechnical engineer to determine its suitability for pavement support. Evaluation should include, but not limited to, compaction testing and proofrolling. If encountered in pavement areas, any unsuitable or unstable materials should be undercut and either replaced with engineered fill or re-compacted in accordance with the recommendations of this report.

An important consideration with the design and construction of pavements is surface and subsurface drainage. Where standing water develops, softening of the subgrade and other problems related to the deterioration of the pavement can be expected. Furthermore, good drainage should minimize the possibility of the subgrade materials becoming saturated over a long time. Based upon the results of the soil test borings, the groundwater table should not significantly affect the performance of pavements; however, surface runoff water that is trapped on the exposed subgrade soils during construction could create localized deterioration of the soil's bearing capacity. Standing water that may develop on the surface of the pavement may be minimized by:

- adequate design (surface graded to control runoff to desired locations - catch basins, drain inlets, gutters, etc.);
- adequate compaction of each lift of pavement section component material (to minimize localized settlements that result in ponding);
- accurate grading of each lift of pavement section component material (to achieve the desired design grades);
- installing temporary weep holes in drainage structures, construction of drainage swales and diversion ditches, and proper backfill and grading behind curbs to minimize water intrusion from behind the curbs.

Roadway subgrades should be constructed and/or prepared in accordance with the recommendations provided in Section 5.0 of this report.

4.7 Underground Storage Tank

Because of the subsurface water levels on this site, we anticipate that water-related excavation issues are likely to arise during construction/excavation. Excavation dewatering will be of primary concern. The method of dewatering will typically be the responsibility of the contractor; however, F&R can review any proposed dewatering methods and provide comments prior to construction.

The proposed underground tanks may bear on the natural (alluvial) soil at the intended depth. Settlements will be on the order of 1 inch. Because the groundwater table appears to be above the proposed bottom of tank excavation, for resistance to hydrostatic uplift, the design should assume that the tanks will be fully submerged. The tanks should be designed against flood levels for this site. As a minimum for uplift design, the dead weight of the structure should be utilized.

5.0 CONSTRUCTION RECOMMENDATIONS

5.1 Site Preparation

Before proceeding with construction, any existing utilities and other deleterious non-soil materials should be stripped or removed from the proposed construction area. All existing fill, abandoned foundations and associated debris must be removed from the building footprint.

During the clearing and stripping operations, positive surface drainage should be maintained to prevent the accumulation of water. Underground utilities should be re-routed to locations a minimum of 10 feet outside of the proposed new structure footprint.

After stripping, areas intended to support foundations, pavements, floor slabs, and new fill should be carefully evaluated by a geotechnical engineer. At that time, the engineer may require proofrolling of the subgrade with a 20- to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. Proofrolling should be performed during a time of good weather and not while the site is wet, frozen, or severely desiccated. The proofrolling observation is an opportunity for the geotechnical engineer to locate inconsistencies intermediate of our boring locations in the existing subgrade especially in the existing fill areas where at-grade slab support, pavement support, or new fill placement is proposed.

Particular attention should be given to any existing utility trenches within the new building footprint. For obvious reasons, existing underground utility trenches were avoided in our drilling program. Our experience is that utility trenches are sometimes backfilled with very little

compactive effort. Where utility lines are removed, the trench subgrade should be verified by an F&R representative prior to backfilling in accordance with the controlled structural fill recommendations provided in this report. If in-place abandonment is preferred, open conduits, pipes, or culverts should be grouted full and the overlying in-place backfill evaluated prior to at-grade and/or new fill construction.

5.2 Foundation Construction

All foundation subgrades should be observed, evaluated, and verified for the design bearing pressure by the geotechnical engineer after excavation and prior to reinforcement steel placement. If low consistency soils are encountered during foundation construction, localized undercutting and/or in-place stabilization of foundation subgrades will be required. The actual need for, and extent of, undercutting should be based on field observations made by the geotechnical engineer at the time of construction.

Excavations for footings should be made in such a way as to provide bearing surfaces that are firm and free of loose, soft, wet, or otherwise disturbed soils. Foundation concrete should not be placed on frozen or saturated subgrades. If such materials are allowed to remain below foundations, settlements will increase. Foundation excavations should be concreted as soon as practical after they are excavated. If an excavation is left open for an extended period, a thin mat of lean concrete should be placed over the bottom to minimize damage to the bearing surface from weather or construction activities. Water should not be allowed to pond in any excavation.

5.3 Controlled Structural Fill

Based on the boring data, controlled structural fill may be constructed using the non-organic on-site soils or an off-site borrow having a classification of CL, ML, SC, SM, or better as defined by the USCS. Other materials may be suitable for use as general controlled structural fill materials and should be individually evaluated by the geotechnical engineer. Controlled structural fill should be free of boulders, organic matter, debris, or other deleterious materials and should have a maximum particle size no greater than 3 inches.

Fill materials should be placed in horizontal lifts with maximum height of 8 inches loose measure. New fill should be adequately keyed into stripped and scarified subgrade soils. During fill operations, positive surface drainage should be maintained to prevent the accumulation of water. We recommend that structural fill be compacted to at least 95 percent of the Standard Proctor maximum dry density. In confined areas such as utility trenches, portable compaction equipment and thin lifts of 3 to 4 inches may be required to achieve specified degrees of compaction.

In general, we recommend that the moisture content of fill soils be maintained within three percentage points of the optimum moisture content as determined from the Standard Proctor density test. Generally, we do not anticipate significant problems controlling moistures within fill during periods of dry weather, but moisture control may be difficult during winter months or extended periods of rain. We recommend that the contractor have equipment on site during earthwork for both drying and wetting of fill soils. Attempts to work the soils when wet can be expected to result in deterioration of otherwise suitable soil conditions or of previously placed and properly compacted fill.

Where construction traffic or weather has disturbed the subgrade, the upper 8 inches of soils intended for structural support should be scarified and re-compacted. Each lift of fill should be tested in order to confirm that the recommended degree of compaction is attained. Field density tests to verify fill compaction should be performed for every 2,500 square feet (approximately 50 feet square) of fill area, with a minimum of two tests per lift. In confined areas, a greater frequency may be required.

5.4 Tank Excavation Recommendations

Due to the nature of the site soils and the potentially high subsurface water levels on this site, it is anticipated that subsurface water will have to be pumped from the tank excavation deeper than approximately 8 feet. Subsurface pumping/dewatering recommendations can be provided upon request during construction.

Nonetheless, the tanks should not be subjected to buoyant forces during installation and should be designed for worst case scenario conditions: empty tank, fully submerged. The design can utilize counter-buoyancy techniques of increasing the weight of the tank or mechanical anchoring such as a reinforced concrete anchor slab or concrete deadman anchors.

5.5 Subsurface Water Conditions

An critical aspect to consider during development of this site is surface water control. During the initiation of grading operations, we recommend that the grading contractor take those steps necessary to enhance surface flow and promote rapid clearing of rainfall and runoff water following rain events. In this regard, it should be incumbent on the contractor to maintain favorable site drainage during construction to minimize deterioration of otherwise stable subgrades.

We recommend that general grading of the site not begin until after late spring, with site work to be completed by mid to late fall. If it is desired to begin site work construction at times other

than late spring through early fall, or if it is anticipated that construction will continue into the winter, the owner should be aware that additional costs may be involved in over-excavating soft, wet, or frozen soils and improving the soil conditions. Standing or ponding water may occur on site during construction, due to conditions such as heavy precipitation or poor drainage conditions. In most instances, surface water conditions can be handled by proper site grading or pumping standing water from excavations. **We recommend that positive drainage of water be maintained away from the site at all times.**

We anticipate that the overall site or excavated areas could be adequately dewatered using diversion ditches, French drains, sump pit and pumping operations, or a combination of these dewatering measures. Below-grade excavations should extend to no closer than 24 inches above perched or static water level before dewatering measures are initiated. Otherwise, subgrade and excavation sidewall destabilization will occur. If the dewatering operations are insufficient, significant difficulties could be experienced in constructing foundations. If required, the sump pit and pumping operations can consist of French drains constructed at or below the proposed subgrade elevation, which are connected to temporary sump pits. The French drains may consist of a 1-foot by 2-foot minimum trench filled with No. 57 stone or equivalent and wrapped in a geotextile. The French drains should be sloped to drain to a temporary sump pit. The sump pits may consist of 55-gallon drums which have been perforated to accept water inflow from the French drains and surrounding soils. The sump pits should be placed several feet below the proposed subgrade elevation. Temporary pumps must be placed in the sump pits to remove the accumulated water.

6.0 CONTINUATION OF SERVICES

We recommend that we be given the opportunity to review the foundation plan, grading plan, and project specifications when construction documents approach completion. This review evaluates whether the recommendations and comments provided herein have been understood and properly implemented. We also recommend that Froehling & Robertson, Inc. be retained for professional and construction materials testing services during construction of the project. Our continued involvement on the project helps provide continuity for proper implementation of the recommendations discussed herein. These services are not part of the currently authorized scope of services.

7.0 LIMITATIONS

This report has been prepared for the exclusive use of DJG, Inc., or their agent, for specific application to the New Kent County Rest Area project in New Kent County, Virginia, in accordance with generally accepted soil and foundation engineering practices. No other warranty, express or implied, is made. Our conclusions and recommendations are based on design information furnished to us, the data obtained from the previously described subsurface exploration program, and generally accepted geotechnical engineering practice. The conclusions and recommendations do not reflect variations in subsurface conditions which could exist intermediate of the boring locations or in unexplored areas of the site. Should such variations become apparent during construction, it will be necessary to re-evaluate our conclusions and recommendations based upon on-site observations of the conditions.

Regardless of the thoroughness of a subsurface exploration, there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. Therefore, experienced geotechnical engineers should evaluate earthwork, pavement, and foundation construction to verify that the conditions anticipated in design actually exist. Otherwise, we assume no responsibility for construction compliance with the design concepts, specifications, or recommendations.

In the event that changes are made in the design or location of the proposed structure, the recommendations presented in the report shall not be considered valid unless the changes are reviewed by our firm and conclusions of this report modified and/or verified in writing. If this report is copied or transmitted to a third party, it must be copied or transmitted in its entirety, including text, attachments, and enclosures. Interpretations based on only a part of this report may not be valid. This report contains 15 pages of text and the attached appendices.

APPENDIX A

SINCE
F&R
1881

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you —* should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes— even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

SINCE
F&R
1881

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

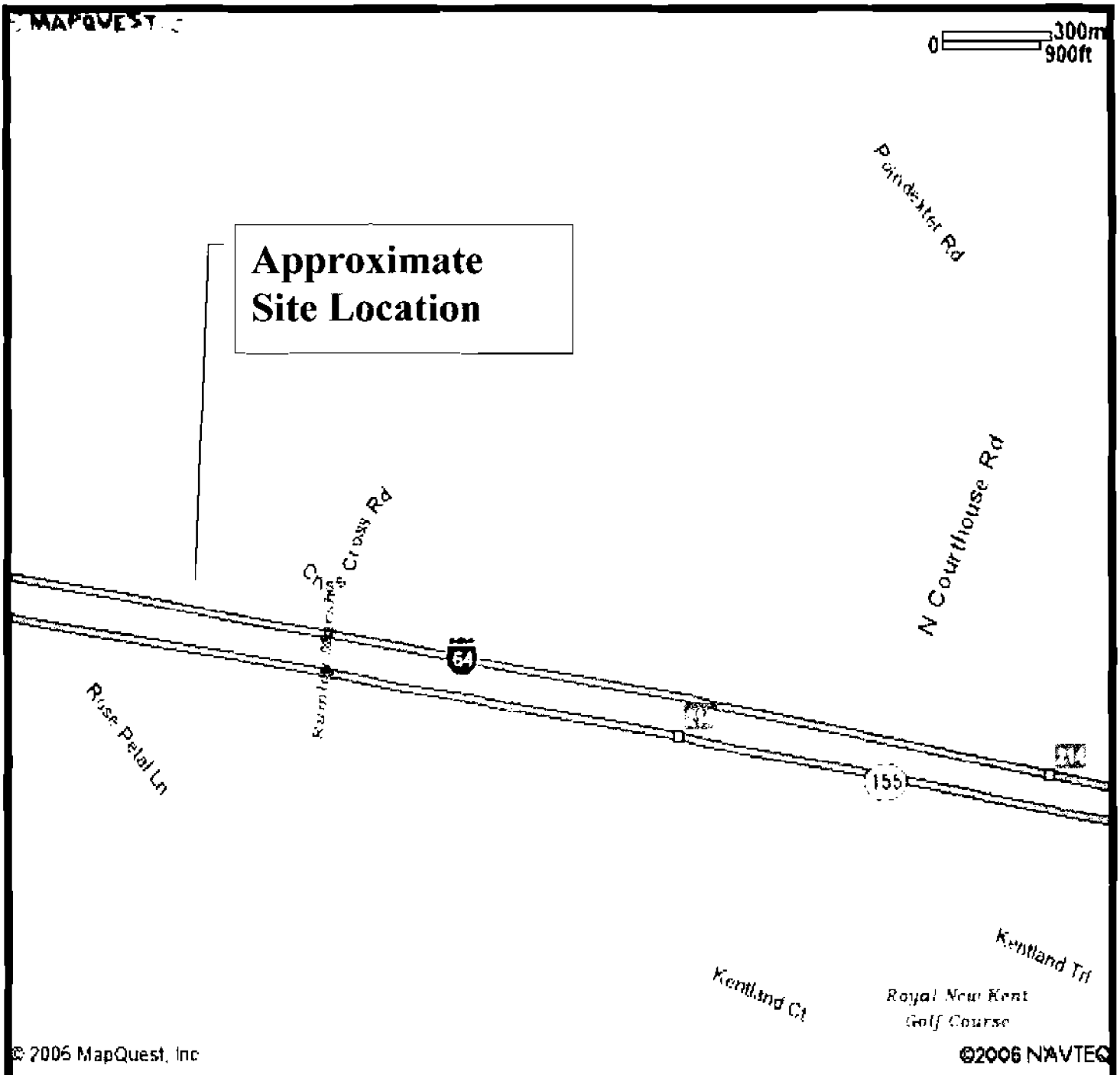
Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

Copyright 2004 by ASFE, Inc. Duplication, reproduction, or copying of this document, in whole or in part, by any means whatsoever, is strictly prohibited, except with ASFE's specific written permission. Excerpting, quoting, or otherwise extracting wording from this document is permitted only with the express written permission of ASFE, and only for purposes of scholarly research or book review. Only members of ASFE may use this document as a complement to or as an element of a geotechnical engineering report. Any other firm, individual, or other entity that so uses this document without being an ASFE member could be committing negligent or intentional (fraudulent) misrepresentation.

IIGER06045.0M



FROEHLING & ROBERTSON, INC GEOTECHNICAL - ENVIRONMENTAL - MATERIALS ENGINEERS - LABORATORIES *"OVER ONE HUNDRED YEARS OF SERVICE"*	DATE: June 2006	
	Source: Mapquest	
	DRAWN: N/A	F&R #1160-0174G
Site Vicinity Map New Kent County Rest Area New Kent County, Virginia	Drawing No. **1**	

APPENDIX B

KEY TO BORING LOG SOIL CLASSIFICATIONS

Particle Size and Proportion

Verbal descriptions are assigned to each soil sample or stratum based on estimates of the particle size of each component of the soil and the percentage of each component of the soil.

Particle Size Descriptive Terms		**Proportion/ Descriptive Terms**		
Soil Component	**Particle Size**	**Component**	**Term**	**Percentage**
Boulder	> 12 inch	Major	Uppercase Letters (e.g., SAND, CLAY)	> 50%
Cobble	3 - 12 inch			
Gravel-Coarse	3/4 - 3 inch			
-Fine	#4 - 3/4 inch	Secondary	Adjective (e.g., sandy, clayey)	20%-50%
Sand-Coarse	#10 - #4			
-Medium	#40 - #10			
-Fine	#200 - #40	Minor	Some	15%-25%
Silt (non-cohesive)	< #200		Little	5%-15%
Clay (cohesive)	< #200		Trace	0%-5%

Notes: 1. Particle size is designated by U.S. Standard Sieve Sizes.
2. Because of the small size of the split-spoon sampler relative to the size of gravel, the true percentage of gravel may not be accurately estimated.

Density or Consistency

The standard penetration resistance values (N-values) are used to describe the density of coarse-grained soils (GRAVEL, SAND) or the consistency of fine-grained soils (SILT, CLAY). Sandy silts of very low plasticity may be assigned a density instead of a consistency.

DENSITY		**CONSISTENCY**	
Term	**N-Value**	**Term**	**N-Value**
Very Loose	0 - 4	Very Soft	0 - 1
Loose	5 - 10	Soft	2 - 4
Medium-Dense	11 - 30	Firm	5 - 8
Dense	31 - 50	Stiff	9 - 15
Very Dense	> 50	Very Stiff	16 - 30
		Hard	> 30

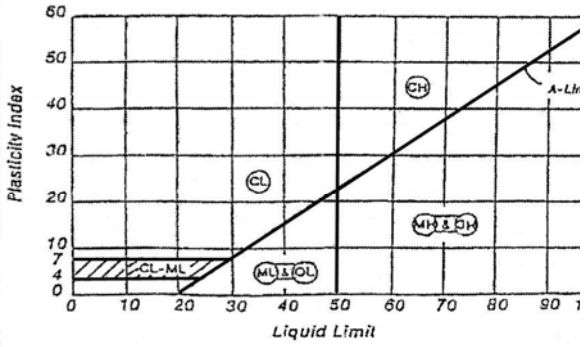
Notes: 1. The N-value is the number of blows of a 140 lb. hammer freely falling 30 inches required to drive a standard split spoon sampler (2.0 in. O.D., 1 3/8 in I.D.) 12 inches into the soil after properly seating the sampler six inches.

2. When encountered, gravel may increase the N-value of the standard penetration test and may not accurately represent the in-situ density or consistency of the soil sampled.

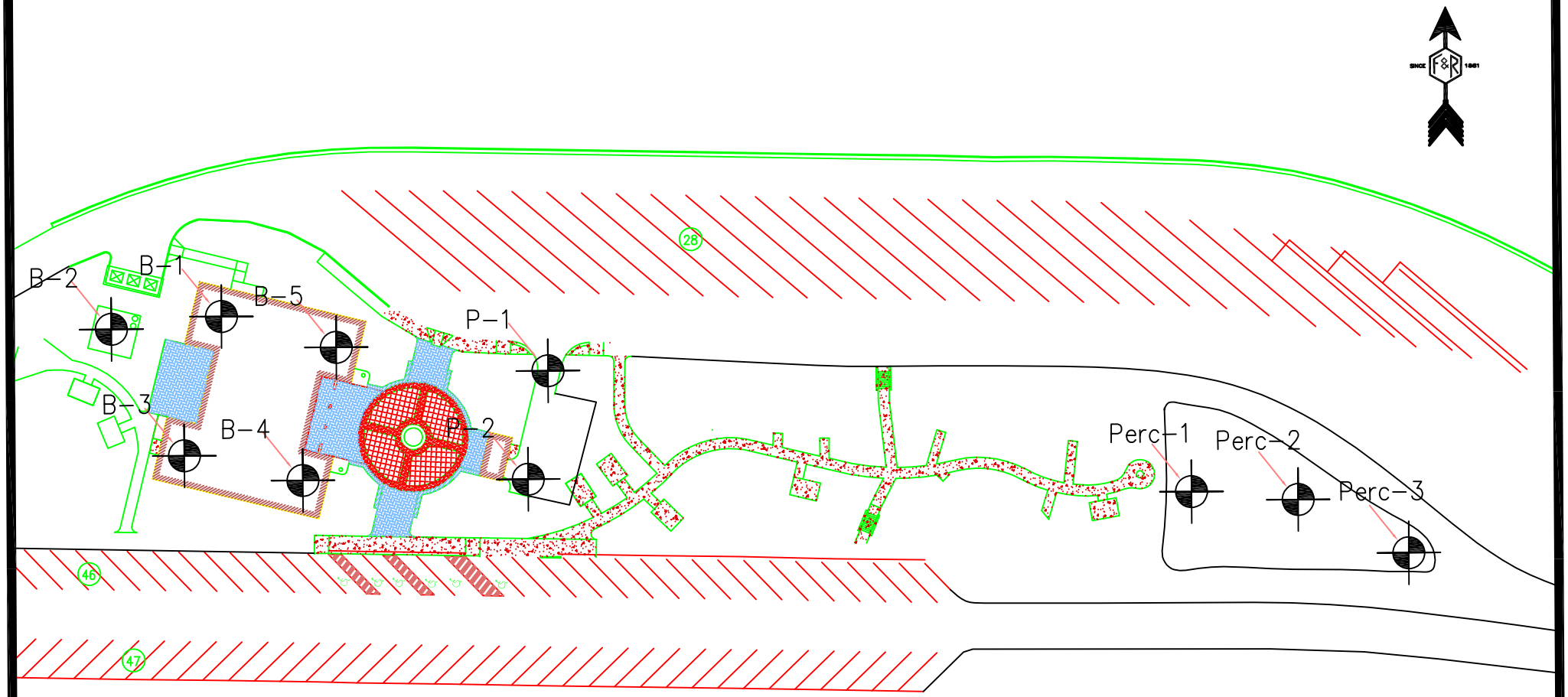
rev. Dec 2001

SOIL CLASSIFICATION CHART - Adapted from ASTM D 2487

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES	CLASSIFICATION CRITERIA
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of lines GW, GP, SW, SP GM, GC, SM, SC Less than 5% pass No. 200 sieve; More than 12% pass No. 200 sieve; 5% to 12% pass No. 200 sieve; Borderline Classification requiring use of dual symbols: $C_u = D_{60}/D_{10}$ Greater than 4; $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines	Not meeting both criteria for GW
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits plot below "A" line and plasticity index greater than 4
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits plot above "A" line and plasticity index greater than 7
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines	$C_u = D_{60}/D_{10}$ Greater than 6; $C_z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			SP	Poorly graded sands and gravelly sands, little or no fines	Not meeting both criteria for SW
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures	Atterberg limits plot below "A" line and plasticity index less than 4
			SC	Clayey sands, sand-clay mixtures	Atterberg limits plot above "A" line and plasticity index greater than 7
FINE-GRAINED SOILS 50% or more passes No. 200 sieve*	SILTS AND CLAYS Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	PLASTICITY CHART For classification of fine-grained soils and fine fraction coarse-grained soils. Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols. Equation of A-line: PI = 0.73 (LL - 20)
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
			OL	Organic silts and organic silty clays of low plasticity	
	SILTS AND CLAYS Liquid limit GREATER THAN 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts	
			CH	Inorganic clays of high plasticity, fat clays	
			OH	Organic clays of medium to high plasticity	
Highly Organic Soils			PT	Peat, muck and other highly organic soils	



*Based on the material passing the 3-in. (75-mm) sieve.



Legend:

Approximate Boring Location

SINCE F&R 1881

Froehling & Robertson, Inc.
3015 Dumbarton Road
Richmond, Virginia 23228

BORING LOCATION PLAN

DJG, Inc.
New Kent County Rest Area
New Kent County, Virginia

DRAWN: FSP	SCALE: NTS	PROJ. NO.: H60-0174G
CHKD: RSF	DATE: 06/06	DWG NO.: 2

BORING LOG

SINCE 1881

FROEHLING & ROBERTSON, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS
ENGINEERS • LABORATORIES
"OVER ONE HUNDRED YEARS OF SERVICE"

Report No.: **H60-0174G** Date: **June 2006**

Client: **DJG, Inc.**

Project: **New Kent Co. Rest Area, I-64 (WBL), New Kent Co., VA**

Boring No.: **B-1** **(1 of 1)** Total Depth **30.0'** Elev: **74.0 ±** Location: **See Boring Location Plan**

Type of Boring: **Hollow Stem Auger** Started: **6/15/06** Completed: **6/15/06** Driller: **Abbott**

Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	* Sample Blows	Sample Depth (feet)	N Value (blows/ft)	REMARKS
73.7	0.3	Driller Reported "Surficial Organic Soils"	1-1-1	0.0		
		Very Loose to Medium Dense, Orangish Brown Clayey Silty SAND - Moist (SC-SM)		1.5	2	Groundwater was encountered at 22' during drilling
			2-2-4	3.0	6	
				3.5		Groundwater was observed at 22' upon removal of auger
			3-4-8	5.0	12	
				6.0		Cave-in depth at 23.5'
			6-8-10	7.5	18	
66.5	7.5	Stiff, Orangish Brown Sandy CLAY - Moist (CL)		8.5		Groundwater was observed at 21', 24 hrs. after completion
			3-5-7	10.0	12	
62.0	12.0	Medium Dense to Very Loose, Tannish Orangish Brown Silty SAND - Moist to Wet (SM)				Cave-in depth at 21.5', 24 hrs. after completion
			4-5-7	13.5		
				15.0	12	
			2-3-4	18.5		
				20.0	7	
			1-2-1	23.5		
				25.0	3	
			1-3-6	28.5		
44.0	30.0	Boring Terminated at 30.0'		30.0	9	

BORING_LOG H60-0174.GPJ F&R.GDT 6/23/06

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N.

BORING LOG

SINCE 1881
FROEHLING & ROBERTSON, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS
ENGINEERS • LABORATORIES
"OVER ONE HUNDRED YEARS OF SERVICE"

Report No.: **H60-0174G** Date: **June 2006**

Client: **DJG, Inc.**

Project: **New Kent Co. Rest Area, I-64 (WBL), New Kent Co., VA**

Boring No.: **B-2** **(1 of 1)** Total Depth **30.0'** Elev: **76.0 ±** Location: **See Boring Location Plan**

Type of Boring: **Hollow Stem Auger** Started: **6/15/06** Completed: **6/15/06** Driller: **Abbott**

Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	* Sample Blows	Sample Depth (feet)	N Value (blows/ft)	REMARKS
75.4	0.6	Driller Reported "Surficial Organic Soils"	1-2-3	0.0		
		Loose, Orangish Brown Silty SAND - Moist (SM)	4-5-7	1.5	5	Groundwater was encountered at 23' during drilling
73.0	3.0			3.0	12	
		Medium Dense, Orangish Reddish Brown Clayey SAND - Moist (SC)	5-6-8	3.5		Groundwater was not observed upon removal of auger
71.0	5.0			5.0	14	
		Medium Dense to Very Loose, Yellowish Orangish Brown Silty SAND - Moist to Wet (SM)	7-10-8	6.0		Cave-in depth at 26'
				7.5	18	
			5-5-5	8.5		Groundwater was not observed, 24 hrs. after completion
				10.0	10	
						Cave-in depth at 22.5', 24 hrs. after completion
			3-5-7	13.5		
				15.0	12	
			3-5-5	18.5		
				20.0	10	
			1-1-2	23.5		
				25.0	3	
			5-1-1	28.5		
46.0	30.0			30.0	2	
		Boring Terminated at 30.0'				

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N.

BORING LOG

SINCE 1881

FROEHLING & ROBERTSON, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS
ENGINEERS • LABORATORIES
"OVER ONE HUNDRED YEARS OF SERVICE"

Report No.: **H60-0174G** Date: **June 2006**

Client: **DJG, Inc.**

Project: **New Kent Co. Rest Area, I-64 (WBL), New Kent Co., VA**

Boring No.: **B-3** **(1 of 1)** Total Depth **30.0'** Elev: **84.0 ±** Location: **See Boring Location Plan**

Type of Boring: **Hollow Stem Auger** Started: **6/15/06** Completed: **6/15/06** Driller: **Abbott**

Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	* Sample Blows	Sample Depth (feet)	N Value (blows/ft)	REMARKS
83.5	0.5	Driller Reported "Surficial Organic Soils"	2-6-10	0.0		
		Medium Dense to Very Loose Orangish Yellowish Brown Silty SAND - Moist to Wet (SM)		1.5	16	Groundwater was encountered at 27' during drilling
			5-3-3	3.0	6	
				3.5		Groundwater was not observed upon removal of auger
			2-3-2	5.0	5	
				6.0		Cave-in depth at 26'
			6-6-6	7.5	12	
				8.5		Groundwater was not observed, 24 hrs. after completion
			4-4-5	10.0	9	
						Cave-in depth at 24.5', 24 hrs. after completion
			4-6-6	13.5		
				15.0	12	
			6-6-7	18.5		
				20.0	13	
			2-3-4	23.5		
				25.0	7	
			2-2-2	28.5		
54.0	30.0			30.0	4	
		Boring Terminated at 30.0'				

BORING_LOG H60-0174.GPJ F&R.GDT 6/23/06

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N.

BORING LOG

SINCE 1881

FROEHLING & ROBERTSON, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS
ENGINEERS • LABORATORIES
"OVER ONE HUNDRED YEARS OF SERVICE"

Report No.: **H60-0174G** Date: **June 2006**

Client: **DJG, Inc.**

Project: **New Kent Co. Rest Area, I-64 (WBL), New Kent Co., VA**

Boring No.: **B-4** **(1 of 2)** Total Depth **60.0'** Elev: **80.0 ±** Location: **See Boring Location Plan**

Type of Boring: **Roller Bit** Started: **6/16/06** Completed: **6/16/06** Driller: **Abbott**

Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	* Sample Blows	Sample Depth (feet)	N Value (blows/ft)	REMARKS
79.6	0.4	Driller Reported "Surficial Organic Soils"	3-4-3	0.0	7	Groundwater data not reported
78.5	1.5	Loose, Tannish Brown Silty SAND, Trace Roots - Moist (SM)	5-6-10	1.5		
				3.0	16	
		Very Stiff to Stiff, Orangish Brown Sandy CLAY - Moist (CL)	3-5-5	3.5		
				5.0	10	
74.0	6.0	Medium Dense to Very Loose, Orangish Tannish Brown Silty SAND - Moist to Wet (SM)	8-8-10	6.0		
				7.5	18	
			6-8-10	8.5		
				10.0	18	
			3-4-6	13.5		
				15.0	10	
			4-4-5	18.5		
				20.0	9	
			2-3-2	23.5		
				25.0	5	
			3-2-6	28.5		
				30.0	8	
			5-6-10	33.5		
				35.0	16	
			1-2-3	38.5		
				40.0	5	

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N.

BORING_LOG H60-0174.GPJ F&R.GDT 6/23/06

BORING LOG

SINCE 1881

FROEHLING & ROBERTSON, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS
ENGINEERS • LABORATORIES
"OVER ONE HUNDRED YEARS OF SERVICE"

Report No.: **H60-0174G** Date: **June 2006**

Client: **DJG, Inc.**

Project: **New Kent Co. Rest Area, I-64 (WBL), New Kent Co., VA**

Boring No.: **B-4** **(2 of 2)** Total Depth **60.0'** Elev: **80.0 ±** Location: **See Boring Location Plan**

Type of Boring: **Roller Bit** Started: **6/16/06** Completed: **6/16/06** Driller: **Abbott**

Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	* Sample Blows	Sample Depth (feet)	N Value (blows/ft)	REMARKS
		Medium Dense to Very Loose, Orangish Tannish Brown Silty SAND - Moist to Wet (SM)	4-4-4	43.5 45.0	8	
			1-1-2	48.5 50.0	3	
			1-2-3	53.5 55.0	5	
			6-11-12	58.5 60.0	23	
20.0	60.0	Boring Terminated at 60.0'				

BORING_LOG H60-0174.GPJ F&R.GDT 6/23/06

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N.

BORING LOG

SINCE 1881
FROEHLING & ROBERTSON, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS
ENGINEERS • LABORATORIES
"OVER ONE HUNDRED YEARS OF SERVICE"

Report No.: **H60-0174G** Date: **June 2006**

Client: **DJG, Inc.**

Project: **New Kent Co. Rest Area, I-64 (WBL), New Kent Co., VA**

Boring No.: **B-5** **(1 of 1)** Total Depth **30.0'** Elev: **75.0 ±** Location: **See Boring Location Plan**

Type of Boring: **Hollow Stem Auger** Started: **6/12/06** Completed: **6/12/06** Driller: **Colvard**

Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	* Sample Blows	Sample Depth (feet)	N Value (blows/ft)	REMARKS
74.5	0.5	Driller Reported "Surficial Organic Soils"	3-7-9	0.0	16	Groundwater data not reported
73.5	1.5	Medium Dense, Gray Silty SAND - Moist (SM-FILL)	8-10-10	1.5		
		Medium Dense to Very Dense, Orangish Brown Sandy CLAY - Moist		3.0	20	
		(CL)	15-29-30	3.5		Cave-in depth at 27.3'
70.0	5.0	Dense to Loose, Orangish Tannish Brown Silty SAND - Moist		5.0	59	
		(SM)	10-15-16	6.0		
				7.5	31	
			4-7-10	8.5		
				10.0	17	
			4-5-7	13.5		
				15.0	12	
			2-3-4	18.5		
				20.0	7	
			7-7-7	23.5		
				25.0	14	
			2-3-7	28.5		
45.0	30.0			30.0	10	
		Boring Terminated at 30.0'				

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N.

BORING LOG

SINCE 1881

FROEHLING & ROBERTSON, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS
ENGINEERS • LABORATORIES
"OVER ONE HUNDRED YEARS OF SERVICE"

Report No.: **H60-0174G** Date: **June 2006**

Client: **DJG, Inc.**

Project: **New Kent Co. Rest Area, I-64 (WBL), New Kent Co., VA**

Boring No.: **P-1** **(1 of 1)** Total Depth **10.0'** Elev: **80.0 ±** Location: **See Boring Location Plan**

Type of Boring: **Hollow Stem Auger** Started: **6/12/06** Completed: **6/12/06** Driller: **Colvard**

Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	* Sample Blows	Sample Depth (feet)	N Value (blows/ft)	REMARKS
79.5	0.5	Driller Reported "Surficial Organic Soils"	1-1-1	0.0	2	Groundwater data not reported
78.5	1.5	Very Loose, Gray Silty SAND - Moist (SM)	1-1-1	1.5	2	
77.0	3.0	Soft, Gray Sandy CLAY - Moist (CL)		3.0		
		Stiff to Very Stiff, Orangish Brown Sandy CLAY - Moist (CL)	3-5-10	3.5	15	Cave-in depth at 8.4'
				5.0		
			4-8-16	6.0		
72.5	7.5	Medium Dense, Orangish Brown Silty SAND - Moist (SM)	5-12-13	7.5	24	
				8.5		
70.0	10.0	Boring Terminated at 10.0'		10.0	25	

BORING_LOG H60-0174.GPJ F&R.GDT 6/23/06

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N.

BORING LOG

SINCE 1881

FROEHLING & ROBERTSON, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS
ENGINEERS • LABORATORIES
"OVER ONE HUNDRED YEARS OF SERVICE"

Report No.: **H60-0174G** Date: **June 2006**

Client: **DJG, Inc.**

Project: **New Kent Co. Rest Area, I-64 (WBL), New Kent Co., VA**

Boring No.: **P-2** **(1 of 1)** Total Depth **10.0'** Elev: **80.0 ±** Location: **See Boring Location Plan**

Type of Boring: **Hollow Stem Auger** Started: **6/12/06** Completed: **6/12/06** Driller: **Colvard**

Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	* Sample Blows	Sample Depth (feet)	N Value (blows/ft)	REMARKS
79.6	0.4	Driller Reported "Surficial Organic Soils"	5-10-12	0.0	22	Groundwater data not reported
		Medium Dense, Brown Silty SAND, Trace Roots - Moist (SM)	5-10-11	1.5		
77.0	3.0	Very Stiff, Orangish Brown Sandy CLAY - Moist (CL)	6-11-17	3.0 3.5	21	
75.0	5.0	Medium Dense, Orangish Brown to Tan Silty SAND - Moist (SM)	6-16-13	5.0 6.0	28	Cave-in depth at 8.4'
			7-15-15	7.5 8.5	29	
70.0	10.0	Boring Terminated at 10.0'		10.0	30	

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the second and third increments of penetration is termed the standard penetration resistance, N.

SINCE
1881
FROEHLING & ROBERTSON, INC.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS
ENGINEERS • LABORATORIES
"OVER ONE HUNDRED YEARS OF SERVICE"
3015 DUMBARTON ROAD • RICHMOND, VIRGINIA 23228
PHONE (804) 264-2701 • FAX (804) 264-7862
Web Site: www.FandR.com

F&R Project No.: H60-0174G

June 26, 2006

DJG, Inc.
449 McLaws Circle
Williamsburg, Virginia 23185
Attention: Mr. Daniel J. DeYoung, P.E.

Reference: Addendum No. 1 - Concrete Pavement Recommendations
New Kent County Rest Area (I-64 WBL)
New Kent County, Virginia

Dear Mr. DeYoung:

As requested, Froehling & Robertson, Inc. (F&R) is providing the following heavy duty concrete pavement recommendations for tractor-trailer parking areas:

Heavy Duty Concrete Pavement - Tractor Trailer Traffic	
Portland Cement Concrete	Minimum 6 inches (4,000 psi compressive)
Aggregate Base	6 inches Aggregate Base Material, Type I, Size 21B, that satisfies VDOT specifications, compacted to 98% of ASTM D 698 or 95% of ASTM D 1557

Concrete pavements should be designed and constructed with joint spacing of no greater than 15 feet. Panels should be relatively square. If rectangular panels are required, the long side should not exceed 1.5 times the short side. Construction joints, where required, should be keyed and/or doweled. Reinforcing should consist of a 4 x 4 – W4.0. "Welded Wire Fabric". [Note: 4 x 4 = mesh opening and W4.0 = smooth wire with size no. (W4 = 0.225 inch diameter / 0.136 pounds/foot)]. The fabric should extend to about 2 inches but no more than 6 inches from the slab edges. The depth from the top of slab should not be less than 2.5 inches or more than mid-depth. The fabric end and side laps should be about 30 times the wire diameter, but not less than 6 inches. Pavement subgrades should be observed and prepared as discussed in the original geotechnical report dated June 23, 2006 submitted under the same job number as this addendum letter (H60-0174G).

Froehling & Robertson, Inc., (F&R) appreciates the opportunity of working with you on this project. Should you have any questions regarding this report, please feel free to contact us at your convenience.

Respectfully,
FROEHLING & ROBERTSON, INC.

Anna M. Kotas, E.I.T.
Geotechnical Engineering Staff

Richard S. Farmer, P.E.
Geotechnical Engineer

COMMONWEALTH OF VIRGINIA
RICHARD S. FARMER
Lic. No.
19366
26 JUN06
PROFESSIONAL ENGINEER

Copies: Addressee (3 copies)

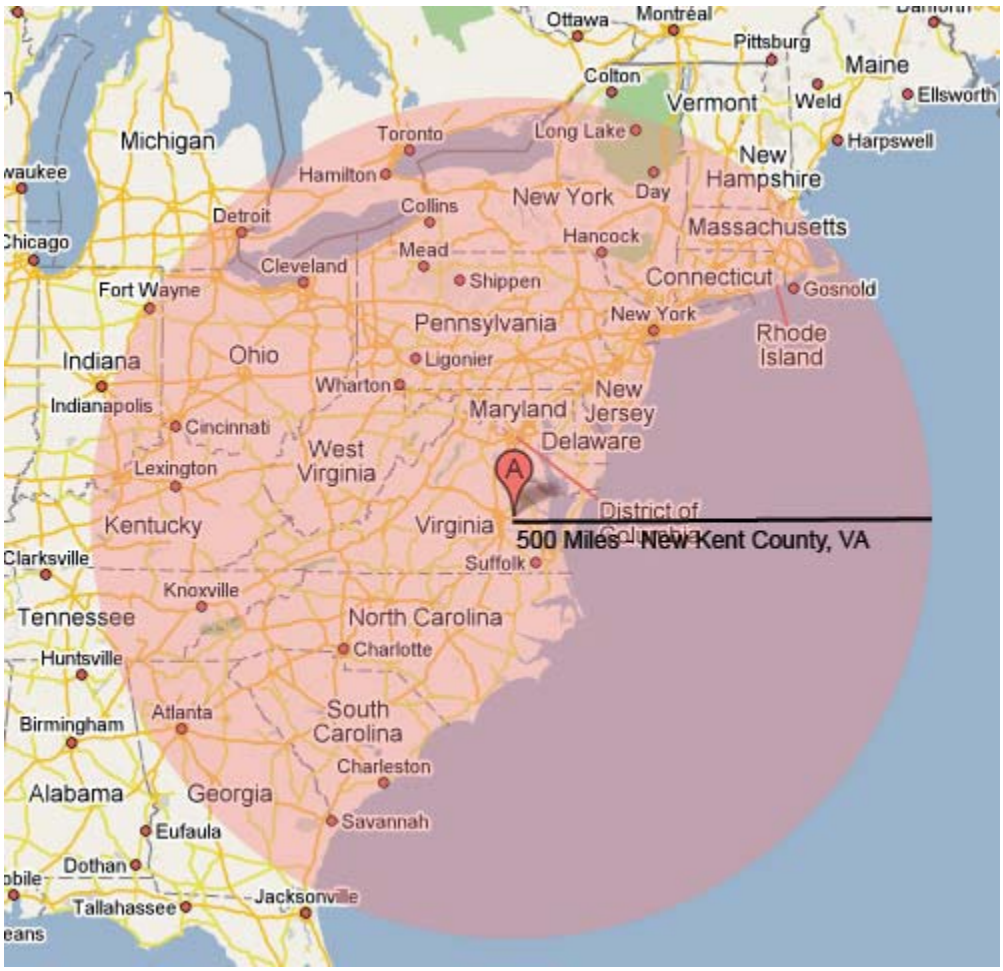
HEADQUARTERS: 3015 DUMBARTON ROAD • BOX 27524 • RICHMOND, VA 23261-7524
TELEPHONE: (804) 264-2701 • FAX: (804) 264-7862 • www.FandR.com

BRANCHES ASHEVILLE, NC • BALTIMORE, MD • CHARLOTTE, NC • CHESAPEAKE, VA
CROZET, VA • FAYETTEVILLE, NC • FREDERICKSBURG, VA
GREENVILLE, SC • HICKORY, NC • RALEIGH, NC • ROANOKE, VA • STERLING, VA

APPENDIX C

New Kent County, VA 500-Mile Radius Map

Refer to Section 01150 “LEED GREEN BUILDING SUMMARY, REQUIREMENTS AND GOALS”.



APPENDIX D

LEED-NC

LEED-NC Version 2.2 Registered Project Checklist

VDOT Safety Rest Area Facility
New Kent County, I-64 Mile Marker 213

Yes	?	No			
6		8	**Sustainable Sites**		14 Points
Y			Prereq 1	**Construction Activity Pollution Prevention**	Required
1			Credit 1	**Site Selection**	1
		1	Credit 2	**Development Density & Community Connectivity**	1
1			Credit 3	**Brownfield Redevelopment**	1
		1	Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
		1	Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
		1	Credit 4.3	**Alternative Transportation**, Low-Emitting and Fuel-Efficient Vehicles	1
		1	Credit 4.4	**Alternative Transportation**, Parking Capacity	1
1			Credit 5.1	**Site Development,** Protect of Restore Habitat	1
1			Credit 5.2	**Site Development,** Maximize Open Space	1
1			Credit 6.1	**Stormwater Design,** Quantity Control	1
1			Credit 6.2	**Stormwater Design,** Quality Control	1
		1	Credit 7.1	**Heat Island Effect,** Non-Roof	1
		1	Credit 7.2	**Heat Island Effect,** Roof	1
		1	Credit 8	**Light Pollution Reduction**	1

Yes	?	No			
4		1	**Water Efficiency**		5 Points
1			Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
1			Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
		1	Credit 2	**Innovative Wastewater Technologies**	1
1			Credit 3.1	**Water Use Reduction**, 20% Reduction	1
1			Credit 3.2	**Water Use Reduction**, 30% Reduction	1

Yes	?	No			
13		2	**Energy & Atmosphere**		17 Points
Y			Prereq 1	**Fundamental Commissioning of the Building Energy Systems**	Required
Y			Prereq 2	**Minimum Energy Performance**	Required
Y			Prereq 3	**Fundamental Refrigerant Management**	Required
10			Credit 1	**Optimize Energy Performance**	1 to 10
		1	Credit 2	**On-Site Renewable Energy**	1 to 3
1			Credit 3	**Enhanced Commissioning**	1
1			Credit 4	**Enhanced Refrigerant Management**	1
1			Credit 5	**Measurement & Verification**	1
		1	Credit 6	**Green Power**	1

continued...

Yes	?	No		
3	1	8	**Materials & Resources**	13 Points

Y					
			Prereq 1	**Storage & Collection of Recyclables**	Required
		1	Credit 1.1	**Building Reuse**, Maintain 75% of Existing Walls, Floors & Roof	1
		1	Credit 1.2	**Building Reuse**, Maintain 100% of Existing Walls, Floors & Roof	1
		1	Credit 1.3	**Building Reuse**, Maintain 50% of Interior Non-Structural Elements	1
1			Credit 2.1	**Construction Waste Management**, Divert 50% from Disposal	1
		1	Credit 2.2	**Construction Waste Management**, Divert 75% from Disposal	1
	1		Credit 3.1	**Materials Reuse**, 5%	1
		1	Credit 3.2	**Materials Reuse**,10%	1
1			Credit 4.1	**Recycled Content**, 10% (post-consumer + ½ pre-consumer)	1
		1	Credit 4.2	**Recycled Content**, 20% (post-consumer + ½ pre-consumer)	1
1			Credit 5.1	**Regional Materials**, 10% Extracted, Processed & Manufactured Region	1
		1	Credit 6	**Rapidly Renewable Materials**	1
		1	Credit 7	**Certified Wood**	1

Yes	?	No		
8		7	**Indoor Environmental Quality**	15 Points

Y					
Y			Prereq 1	**Minimum IAQ Performance**	Required
			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	Required
1			Credit 1	**Outdoor Air Delivery Monitoring**	1
		1	Credit 2	**Increased Ventilation**	1
1			Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
		1	Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
1			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
1			Credit 4.2	**Low-Emitting Materials**, Paints & Coatings	1
		1	Credit 4.3	**Low-Emitting Materials**, Carpet Systems	1
1			Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products	1
		1	Credit 5	**Indoor Chemical & Pollutant Source Control**	1
		1	Credit 6.1	**Controllability of Systems**, Lighting	1
		1	Credit 6.2	**Controllability of Systems**, Thermal Comfort	1
1			Credit 7.1	**Thermal Comfort**, Design	1
1			Credit 7.2	**Thermal Comfort**, Verification	1
		1	Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
1			Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1

Yes	?	No		
5			**Innovation & Design Process**	5 Points

1			Credit 1.1	**Innovation in Design**: Exceptional water use reduction	1
1			Credit 1.2	**Innovation in Design**: Educational sign use	1
1			Credit 1.3	**Innovation in Design**: Green Housekeeping	1
1			Credit 1.4	**Innovation in Design**: Site adaptation for no parking surface removal	1
1			Credit 2	**LEED® Accredited Professional**	1

Yes	?	No		
39	1		**Project Totals (pre-certification estimates)**	69 Points

Certified 26-32 points **Silver** 33-38 points **Gold** 39-51 points **Platinum** 52-69 points

APPENDIX E

Scope of Work
Remediation of Impacted Soil

This scope of work assumes that all applicable permits for construction will have been obtained by the general contractor (GC). No specific permits for remediation are required. This scope of work also assumes the GC will provide the heavy equipment, operator, labor and clean fill to perform the excavation of impacted soil.

Based on the Phase II ESA, dated July 28, 2006, it is estimated that the amount of [mineral oil] petroleum-impacted soil is 45 tons. The concentration of mineral oil ranges from a 2,000-mg/kg to at least 13,000-mg/kg. The maximum depth of impacted soil to be recovered is estimated to be 5-ft. The scope of work is as follows:

- GC must coordinate schedule and site remediation activities with the VDOT environmental inspector (EI).
- GC should be aware that petroleum contaminated soil will be encountered below the building slab and shallow soil around the building as shown on Figure 2 from the Phase II ESA.
- The EI will join the GC on site at the time of excavation services to provide environmental oversight and to inform GC of limits of excavation around restroom building and adjacent to the 2nd turn in the mineral oil pipelines.
- The EI will coordinate, schedule, and manage transportation, treatment, and disposal of the impacted soil including all manifests and reporting.
- Once transportation is onsite, the GC can begin excavation of impacted soil under direction of the EI. Approximately 2 truck loads of impacted soil are expected to be recovered from beneath and adjacent to the restroom building as shown on Figure 2 from the Phase II ESA. Approximately 2 truck loads of impacted soil are expected to be recovered from adjacent to the 2nd pipeline turn. It is estimated that 45 tons of impacted soil will be removed from the site.
- If additional impact is detected during excavation, the EI will notify the appropriate VDOT representative and get authorization to proceed with the additional removal before continuing with that work.
- The EI will have to collect up to 5 confirmation samples of soil from a combination of both excavations to verify that impacted soil has been removed. The GC will make provisions to facilitate this collection (i.e., retrieving samples using excavator or providing access to the excavation pit).
- Once removal activities are complete, the GC can backfill the excavation, or grade as required by construction site plans. The backfill soil will be provided by the GC. As the site will be rebuilt upon, the backfill soil quality and compaction

must be approved by a geotechnical engineer or site superintendent for the intended construction.

- The supply and waste oil pipelines were previously emptied and cleaned, however some oil may remain inside the pipes. The GC should be prepared to recover any remaining oil during pipe removal. In addition, subsurface conditions along the pipelines beyond the 2nd turn from the restroom building were inspected at 50-ft intervals and found to be petroleum free. If the pipes are to be removed or exposed, any oil release from the pipes along that interval should be reported to the EI upon discovery and earthwork in that area should be suspended until authorized to proceed by VDOT.

PHASE II
ENVIRONMENTAL SITE ASSESSMENT

Conducted On:

NEW KENT REST AREA
INTERSTATE 64 WESTBOUND
NEW KENT, VIRGINIA

MSA Project # 0415EE

Prepared For:

VIRGINIA DEPARTMENT OF TRANSPORATION
1401 EAST BROAD STREET
RICHMOND, VIRGINIA

Issue Date: July 28, 2006

Prepared By:

MSA, P.C.
5033 ROUSE DRIVE
VIRGINIA BEACH, VIRGINIA 23462
TEL (757) 490-9264 FAX (757) 490-0634
www.msaonline.com

PHASE II
ENVIRONMENTAL SITE ASSESSMENT

Conducted on:
NEW KENT REST AREA
INTERSTATE 64 WESTBOUND
NEW KENT, VIRGINIA

MSA Project # 04154EE

For:

VIRGINIA DEPARTMENT OF TRANSPORTATION
1401 EAST BROAD STREET
RICHMOND, VIRGINIA

Issue Date: July 28, 2006

Prepared By:

Charles H. Hall, P.G.
Associate - Hydrogeologist

Signature

MSA, P.C.
5033 Rouse Drive
Virginia Beach, VA 23462
TEL (757) 490-9264 FAX (757) 490-0634
www.msaonline.com

EXECUTIVE SUMMARY

MSA, P.C., has completed a limited scope Phase II Environmental Site Assessment for the subject property identified as the Virginia Department of Transportation's Westbound New Kent Rest Area located on Interstate 64 at mile 213 in New Kent, Virginia. The scope of this study was to determine if the subject property has been environmentally impacted due to previous usage by activities on the property. It should be noted that this Phase II ESA was conducted without the benefit of a Phase I ESA.

The subject property consists of one large brick building with both men's and women's restrooms, a smaller brick building with vending machines, a forested area with picnic tables and maintenance sheds, a waste collection building/ pump house located at the back of the property, and an asphalt parking area. The purpose of this investigation was to investigate the possibility of subsurface contamination based on the properties' previous usage of a mineral oil wastewater conveyance system.

Subsurface conditions were evaluated in suspect areas across the subject property. Soil samples were collected and inspected for potential impact by mineral oil. Impact was observed along the east side of the restroom building, along the second turn in the mineral oil pipelines leading from that building, and around the wastewater treatment building. Four soil samples collected from the impacted areas were analyzed for the diesel range of petroleum hydrocarbons. The analyzed samples contained moderate to high concentrations of mineral oil. The contamination was delineated around the restroom building and second pipeline turn and volume of contaminated soil was quantified. The level of contamination in these areas is great enough to require reporting. The VDEQ should be notified of this discovery within 24-hours of receipt of this report. We recommend conducting a cleanup of the area during construction of the replacement facility, however the DEQ may require a more immediate response. Impact around the wastewater treatment building should be further evaluated. The graywater drainfield across the car parking lot should also be evaluated for potential mineral oil impact.

TABLE OF CONTENTS

RICHMOND, VIRGINIA III

EXECUTIVE SUMMARY I

TABLE OF CONTENTS II

1.0 INTRODUCTION 1

1.1 Purpose and Scope of Work 1

1.2 Site Description 1

1.3 Old Wastewater Systems 2

1.4 Site History 3

2.0 METHODS 5

3.0 RESULTS 7

4.0 CONCLUSIONS AND RECOMMENDATIONS 9

4.0 CONCLUSIONS AND RECOMMENDATIONS 9

APPENDICES:

Appendix A – Site Maps (Figures 1, 2, and 3)

Appendix B – Laboratory Report

Appendix C – Qualifications and Limitations

1.0 INTRODUCTION

The Virginia Department of Transportation's Westbound New Kent Rest Area is located on Westbound Interstate 64 at mile 213 and is referred to hereinafter as "subject property". The subject property is currently in use as a public rest area facility for Interstate travelers.

VDOT retained MSA to perform a limited scope Phase II ESA on the subject property in order to evaluate the subsurface environmental condition with respect to potential mineral oil contamination from previous site activities.

1.1 Purpose and Scope of Work

The purpose of this investigation was to assess the environmental integrity of the subject property with respect to previous operation of a mineral oil conveyance system for sewage. This Phase II ESA was conducted in conformance with standard practices and principles in the fields of environmental science and engineering. This report presents the findings, conclusions, and recommendations of that investigation. All evidence used in support of the findings for this aspect of the investigation is provided in the Appendices.

1.2 Site Description

VDOT's New Kent Rest Area, is located on the westbound side of Interstate 64 at mile 213 just before the New Kent exit (Figure 1). The facility is currently operational. It contains an Interstate off-ramp deceleration lane and an on-ramp acceleration lane and a rest area. The rest area facility has one brick restroom building, a smaller brick building with vending machines, an open wooded area with picnic tables and tool sheds, a potable water pump house, wastewater treatment building, and paved parking areas.

The rest area building contains men's and women's restrooms separated by a covered breezeway, alternate restrooms, and a janitorial/utility room.

The site is bounded to the north by forested/agricultural land and to the south by Interstate 64. The newly renovated Eastbound Rest Area lies further south. The site is bound to the east and to the west by forested/ agricultural land.

Based on the Providence Forge, Virginia 7.5-minute topographic map, the site lies approximately 50-ft to 80-ft above mean sea level (Figure 1). The nearest body of surface water is the Rumley Marsh creek, which lies approximately 200-ft. east of the site. Based on relationships between topography and surface water as interpreted from the topographic map, groundwater beneath the site is inferred to occur approximately 20-ft below ground surface over much of the site except for groundwater near the wastewater treatment building that should occur around 5-ft to 10-ft below ground surface and also likely flows east towards the creek.

1.3 Old Wastewater Systems

The focus of this investigation is with the facilities' former wastewater system. This system utilized mineral oil as a waste conveyance medium. Similar facilities have reported accidental releases of this oil.

The wastewater system at this facility began at the point of generation (restrooms) where sewage was collected through a common header. It was then transported to the wastewater treatment building using mineral oil as a conveyance medium. The distribution pipe leads from the east side of the restroom building toward the truck parking lot and then below the hillslope parallel with the parking lot sidewalk until crossing the parking lot and to the wastewater treatment building. The oil lines are approximately 300 feet in length and entirely below ground (Figure 2). The waste and oil were separated in a tank in the building where the oil was processed before being returned to the restroom building to complete the cycle. This system was designed to be zero discharge; collected waste was processed in the treatment building where

solids were eventually disposed by incineration. The wastewater system was replaced sometime after 2001 with a new treatment and disposal system. Accidental releases from system piping and components have reportedly impacted similar facilities, thus there is a potential for similar impacts to have occurred at this facility.

Sink wastewater and floor drains were tied into a septic tank off the southeast corner of the restroom building. Graywater effluent from the tank was then piped across the automobile parking area and to the grass field adjacent to the Interstate where it was disposed underground through a subsurface soil absorption system (drainfield). This waste is now tied into the new sewage treatment system. Overflowing mineral oil from backed up toilets and urinals that leaked mineral oil to the floor were likely washed down the floor drain. Therefore, there is a potential for oily waste to have impacted the environment in the area of the sewage drainfield.

The wastewater treatment building housed treatment equipment and fresh and spent mineral oil. The floor drain (and possibly other features) associated with this building drain into an oil-water separator (OWS) along the east side of the rear concrete deck. Considering the amount of oil stored and used in this building and considering the oil-stained nature of the concrete floor, it is likely that leaked mineral oil washed off the concrete floor and onto the adjacent ground surface. It is also possible that the oily water that had accumulated in the OWS either leaked out through joints and cracks or overflowed due to poor maintenance. In this manner, there is a potential for surface and subsurface oil impact around the OWS.

1.4 Site History

The land was vacant until the Virginia Department of Transportation built the rest area around 1963; the property has been used as a rest area since that time. In the late 1970's, VDOT installed oil recirculating, or non-water carriage toilets. This type of system offers a benefit to remotely located properties where connection to piped sanitary systems is cost prohibitive and water resources are either limited or too costly

to utilize. In this system, human wastes are deposited into a mineral oil medium. The water-based urine and solid-based products separate from the oil medium, which is subsequently reused in the toilets. The wastes are then piped to a collection facility for treatment and disposal.

In 2001, VDOT became concerned that recycling mineral oil systems required constant maintenance and the mineral oil must be replenished on a periodic basis due to breakdown. For these reasons, the system was replaced with a more conventional sanitary system sometime after 2001. The subject property is awaiting renovations that are slated to be finished by June 2007.

No documentation of known releases at this facility was made available by VDOT for review. Onsite interview with facility personnel reveal that the oil portion of the wastewater system was prone to problems that resulted in accidental releases of oily product to the environment.

2.0 METHODS

The field investigation was conducted on July 13 and July 19, 2006. Since the oil pipelines were cut and abandoned, standard electro-conductive utility line locating techniques would not be effective. NAEVA Geophysics, a geophysical survey company, located the mineral oil lines using an electro-inductive technique. Sample locations were strategically selected based on the located pipelines, facility configuration, and current site observations. Samples were collected at 50-ft intervals along the length of oil pipelines. No samples were collected below the truck parking lot as the pipelines turned toward the wastewater treatment building.

A total of 34 locations were investigated. Twenty-nine locations were advanced at locations along the oil pipelines across the subject property using a stainless steel hand auger and inspected for evidence of petroleum contamination. Five locations were conducted around the wastewater treatment building were inspected using an Earthprobe™ direct-push hydraulic sampler. The boring locations are shown on Figure 2. Upon completion of borings and probes, all holes were backfilled with retrieved soil and, if needed, finished off with asphalt patch to match the existing pavement.

Olfactory and visual observations were used to identify soils that were potentially contaminated with mineral oil. Once these soils were identified, the lateral and vertical extent of contamination was determined and samples were collected from the representative depths.

Four soil samples were selected for laboratory analysis. They were collected from soil borings conducted around the restroom building, along the pipeline, and from adjacent to the OWS behind the wastewater treatment building. All samples were placed in laboratory-prepared containers with the appropriate preservatives and placed on ice to 4 degrees Celsius. The samples were then shipped under chain of custody to EnviroCompliance Laboratories in Hampton, Virginia for analyses of Total Petroleum

Hydrocarbons using EPA Method 8015B (TPH-Diesel Range Organics). The laboratory report, chain of custody and sampling protocol are included as Appendix B.

3.0 RESULTS

Soils encountered throughout the property shared the same general textural types. In general there was 4 to 6 feet of sandy clay probable-fill. Groundwater was not encountered in soil borings around the restroom building or around the pipeline below the hillslope.

Mineral oil contamination was discovered around the east side of the restroom building, and around the second turn along the pipeline away from the building. Minor oil staining was observed on the surficial soil and a lower portion of brick wall outside the janitor's room on the east side of the restroom building. The extent of contamination around the restroom building and along the pipeline is shown on Figure 2.

Heavy oil staining was also observed on the floor of the wastewater treatment building and on the concrete pad outside the building. Surficial and subsurface impact was also observed around the OWS and concrete pad behind the wastewater building. SS-3 collected from beside the OWS had a petroleum concentration of 2,781.5-mg/kg. Plume delineation around the wastewater building will be performed at a later date during a follow-up investigation. Inspection of the sewage drainfield will also be conducted during the follow-up phase of investigation.

In general, oil contamination around the restroom building extends from 12"-24" to a depth of 48"-60" below the ground surface. The occurrence of oil ranged from light petroleum staining (residual phase) with strong vapor phase to nearly oil-saturated conditions. Laboratory results of a sample from near the center of the building (SS-1) revealed oil-saturated concentrations (13,497-mg/kg) by a light oil product. Off the northeast corner of the building (SS-2), moderate residual oil contamination was detected (3935.5-mg/kg). The chromatograms of this product is consistent with mineral oil (Appendix B). Free oil product was not encountered is likely present locally below the point of release. While contamination exists beneath the men's restroom, previous and current borings did not reveal subsurface impact extending further west beyond that

portion of the building. Based on the results of this investigation, the amount of impacted soil around the restroom is estimated to be 13 cubic yards.

Oil contamination at the second turn in the pipeline extends from 12”-18” to a depth of 48”-60” below the ground surface. This occurrence of oil was mostly a moderate level of residual phase oil with moderate petroleum odor. Sample SS-4 contained 1,064.0-mg/kg of light oil. Based on the results of this investigation, the amount of impacted soil along the hillslope is estimated to be 11 cubic yards.

No other impact was detected along the front portion of the sewage treatment building or along the remaining length of oil pipelines based on a 50-ft sample intervals.

Table 1. Soil sample analytical results.

Date	Sample ID	Depth	TPH-DRO mg/kg
7/13/2006	SS-1	48"	13497.8
7/13/2006	SS-2	36"	3935.5
7/13/2006	SS-3	48"	2781.5
7/19/2006	SS-4	36"	1064.0
DEQ reporting level: 100-mg/kg			

4.0 CONCLUSIONS AND RECOMMENDATIONS

MSA, P.C., has completed this limited scope Phase II ESA of the subject property identified as the Virginia Department of Transportation's I-64 Westbound New Kent Rest Area. This Phase II ESA investigated the subject property for the presence of mineral oil contamination from accidental releases from the facilities former wastewater treatment system.

Shallow surface and subsurface impact by mineral oil was observed along the east side of the restroom building wall and below the ground surface along much of that wall. The oil is expected to extend below the building and concentrated along the oil pipe that traverses the center of the building. The contamination was not observed below 6-ft so groundwater is not likely impacted. The concentration of oil in soil around this area is well over the DEQ reporting level. While an oil release had previously been reported to the DEQ and a cleanup performed, the current level of contamination is likely higher than what was previously known by the DEQ. Therefore, this condition should be reported to the DEQ. The level of impact is very high and cleanup is warranted and recommended. This area would be most effectively remediated after building demolition for construction of the proposed new rest area facility.

Subsurface impact by mineral oil was also observed around the second turn along the oil pipelines leading away from the restroom building. The contamination there was not observed below 6-ft so no groundwater impact is expected. The concentration at this location exceeds the reporting level. This area may not have been associated with the former release that was reported to the DEQ and thus would constitute a second release that should be reported. Based on the oil concentrations present in this area, cleanup is warranted and recommended. Remediation could be conducted now (prior to planned site construction activities), but it would be more cost effective to conduct this cleanup in conjunction with the restroom building area remediation. No sensitive potential receptors were identified during this investigation that would warrant immediate corrective action. Since the pipelines were emptied and cleaned (as

reported in a previous investigation report), no initial abatement measures or safety hazard mitigation measures are necessary. We recommend waiting to remediate this area until construction activities begin.

Assuming that heavy equipment will be onsite for the demolition and construction activities, the cost for hauling, treatment, and disposal of the impacted soil is estimated to be $6,000. This includes environmental inspector oversight and reporting to the regulatory agency. If additional corrective action becomes necessary, then unit cost for additional soil remediation is as follows:

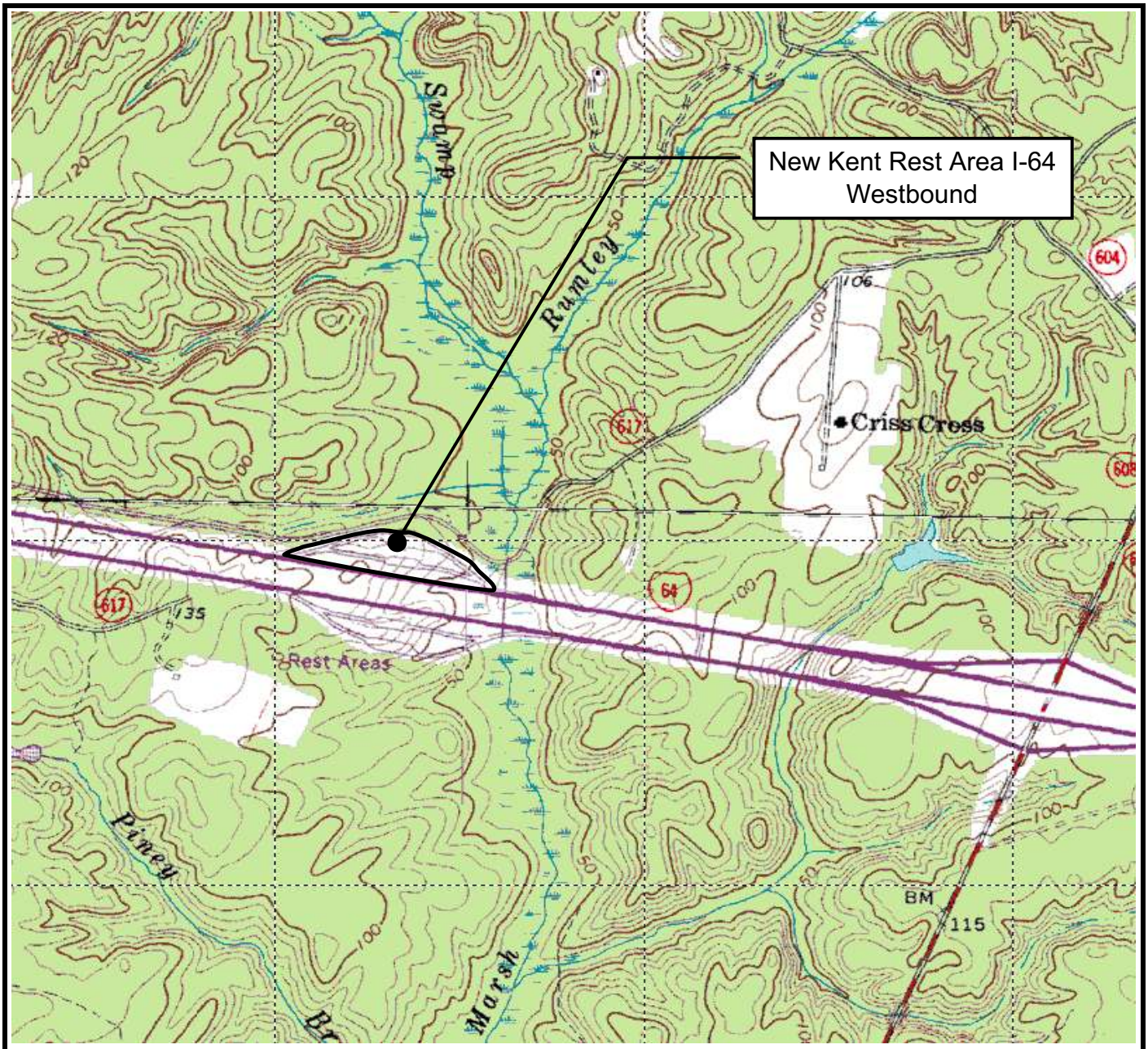
Hauling = $290.00/truck load;

Treatment/disposal = $39.00/ton.

Subsurface impact was detected around the wastewater treatment building and could very easily exist in and around the sewage drainfield. These areas should be investigated to assess potential environmental concerns as soon as possible.

APPENDIX A

Figures



Source: *Providence Forge and Tunstall, Virginia USGS Quadrangle Topographic Map*

FIGURE 1. USGS SITE MAP

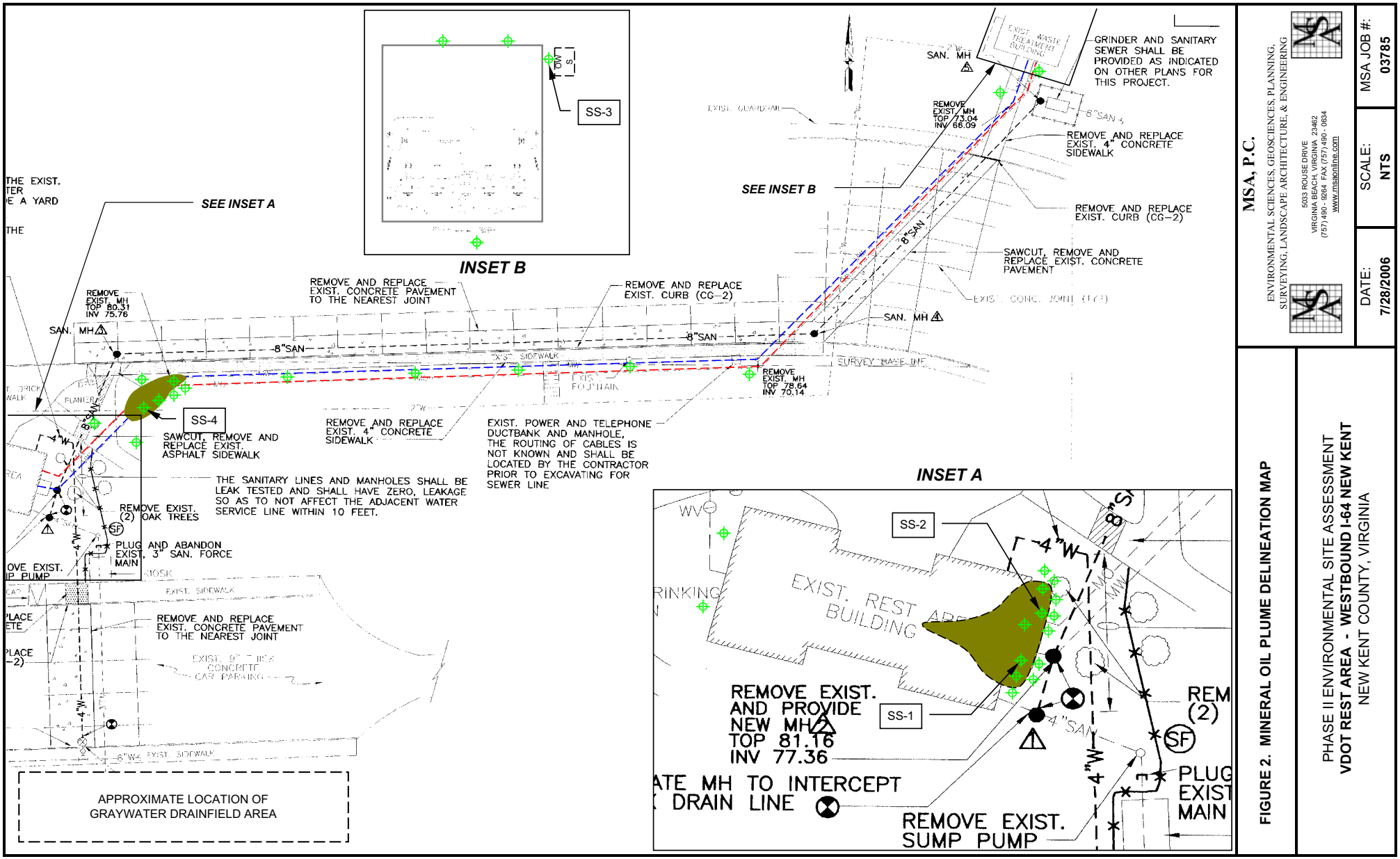
PHASE II ENVIRONMENTAL SITE ASSESSMENT
VDOT I-64 NEW KENT REST AREA
I-64 WEST - MILE 213
NEW KENT COUNTY, VIRGINIA

MSA, P.C.

ENVIRONMENTAL SCIENCES, GEOSCIENCES, PLANNING,
SURVEYING, ENGINEERING & LANDSCAPE ARCHITECTURE

5033 ROUSE DRIVE
VIRGINIA BEACH, VIRGINIA 23462
(757) 490 - 9264 FAX (757) 490 - 0634
www.msaonline.com

DATE:	SCALE:	MSA JOB #:
12/9/2005	**NTS**	**04154EE**



MSA, P.C.
ENVIRONMENTAL SCIENCES, GEOSCIENCES, PLANNING, SURVEYING, LANDSCAPE ARCHITECTURE, & ENGINEERING
5033 ROUSE DRIVE
VIRGINIA BEACH, VIRGINIA 23462
(757) 490 - 9264 FAX (757) 490 - 0634
www.msaonline.com

MSA JOB #: 03785
SCALE: NTS
DATE: 7/28/2006

FIGURE 2. MINERAL OIL PLUME DELINEATION MAP

PHASE II ENVIRONMENTAL SITE ASSESSMENT
VDOT REST AREA - WESTBOUND I-64 NEW KENT
NEW KENT COUNTY, VIRGINIA

APPENDIX B

Laboratory Report

ENVIROCOMPLIANCE LABORATORIES, INC.

816 Kiwanis Street
Hampton, Virginia 23661
Phone 804 · 244 · 3424
Fax 804 · 244 · 3243

Certificate of Analysis

MSA, P.C.
Attn: Charles Hall
5033 Rouse Drive
Virginia Beach, VA 23462

Project Name : New Kent-Eastbound Rest Area
Date Received: July 17, 2006
Date Issued : July 24, 2006

Lab # 1/Sample ID : SS-1 @ 48"

Parameter	Result	Units	DL	Date/Time Prepared	Date/Time Analyzed	Method	Analyst
TPH-DRO	13497.8	mg/kg	5.0	07-19/1030	07-19/1713	8015B	AEM

Lab # 2/Sample ID : SS-2 @ 36"

Parameter	Result	Units	DL	Date/Time Prepared	Date/Time Analyzed	Method	Analyst
TPH-DRO	3935.5	mg/kg	5.0	07-19/1030	07-21/0900	8015B	AEM

Lab # 3/Sample ID : SS-3 @ 48"

Parameter	Result	Units	DL	Date/Time Prepared	Date/Time Analyzed	Method	Analyst
TPH-DRO	2781.5	mg/kg	5.0	07-19/1030	07-21/0900	8015B	AEM

BDL = Below Detection Limit

Aramarie E. McKinley
Laboratory Manager

H6718694-1

ENVIROCOMPLIANCE LABORATORIES, INC.

816 Kiwanis Street
Hampton, Virginia 23661
Phone 804 · 244 · 3424
Fax 804 · 244 · 3243

Certificate of Analysis

MSA, P.C.
Attn: Charles Hall
5033 Rouse Drive
Virginia Beach, VA 23462

Project No. : 041543E
Project Name : New Kent- East Bound Rest Area
Date Received: July 21, 2006
Date Issued : July 27, 2006

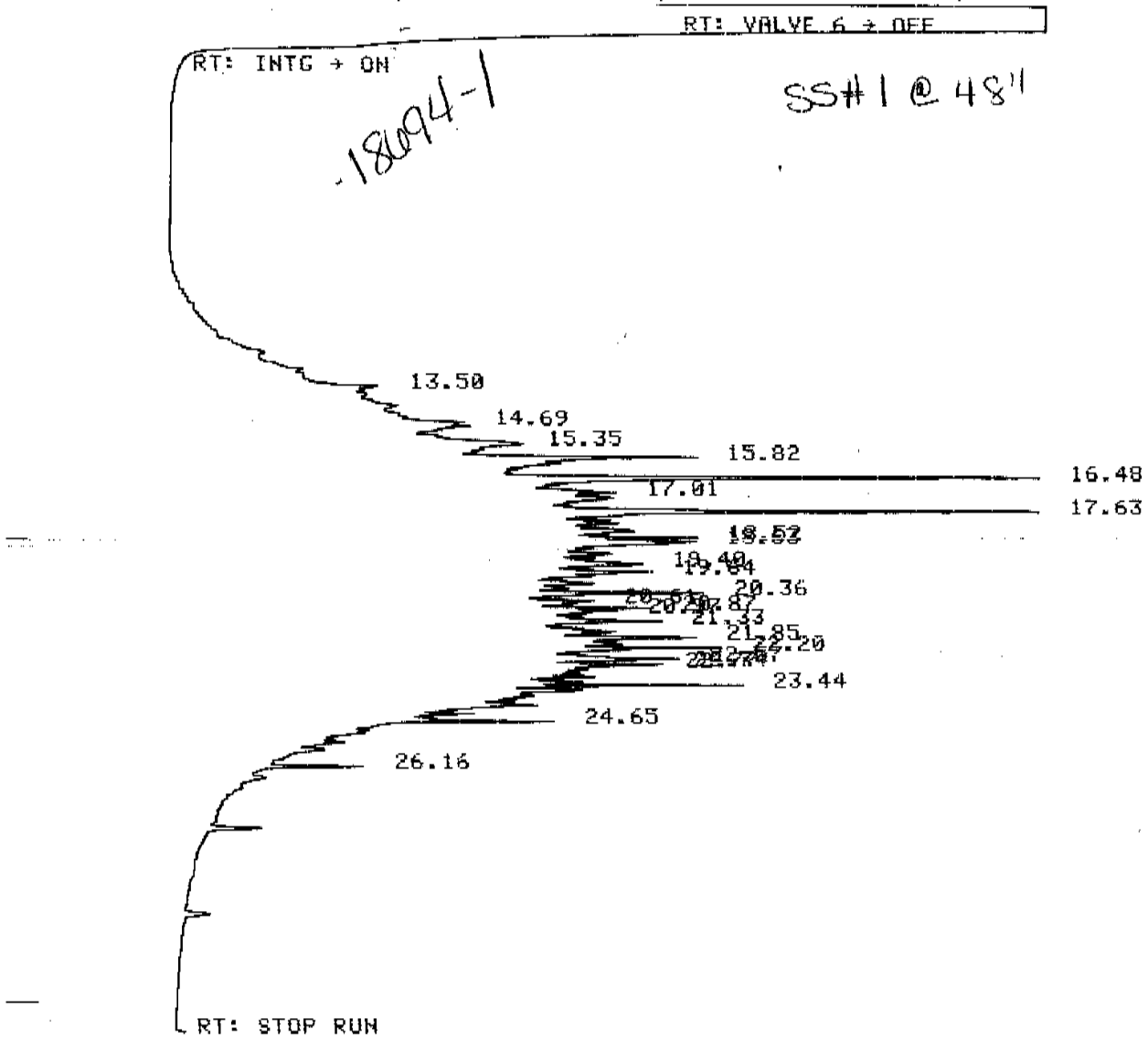
Sample ID : SS-4 @36"

Parameter	Result	Units	DL	Date/Time Prepared	Date/Time Analyzed	Method	Analyst
TPH-DRO	1064.0	mg/kg	5.0	07-24/1110	07-26/0901	8015B	AEM

BDL = Below Detection Limit

Anamarie E. McKinley
Laboratory Manager

H6718717-1

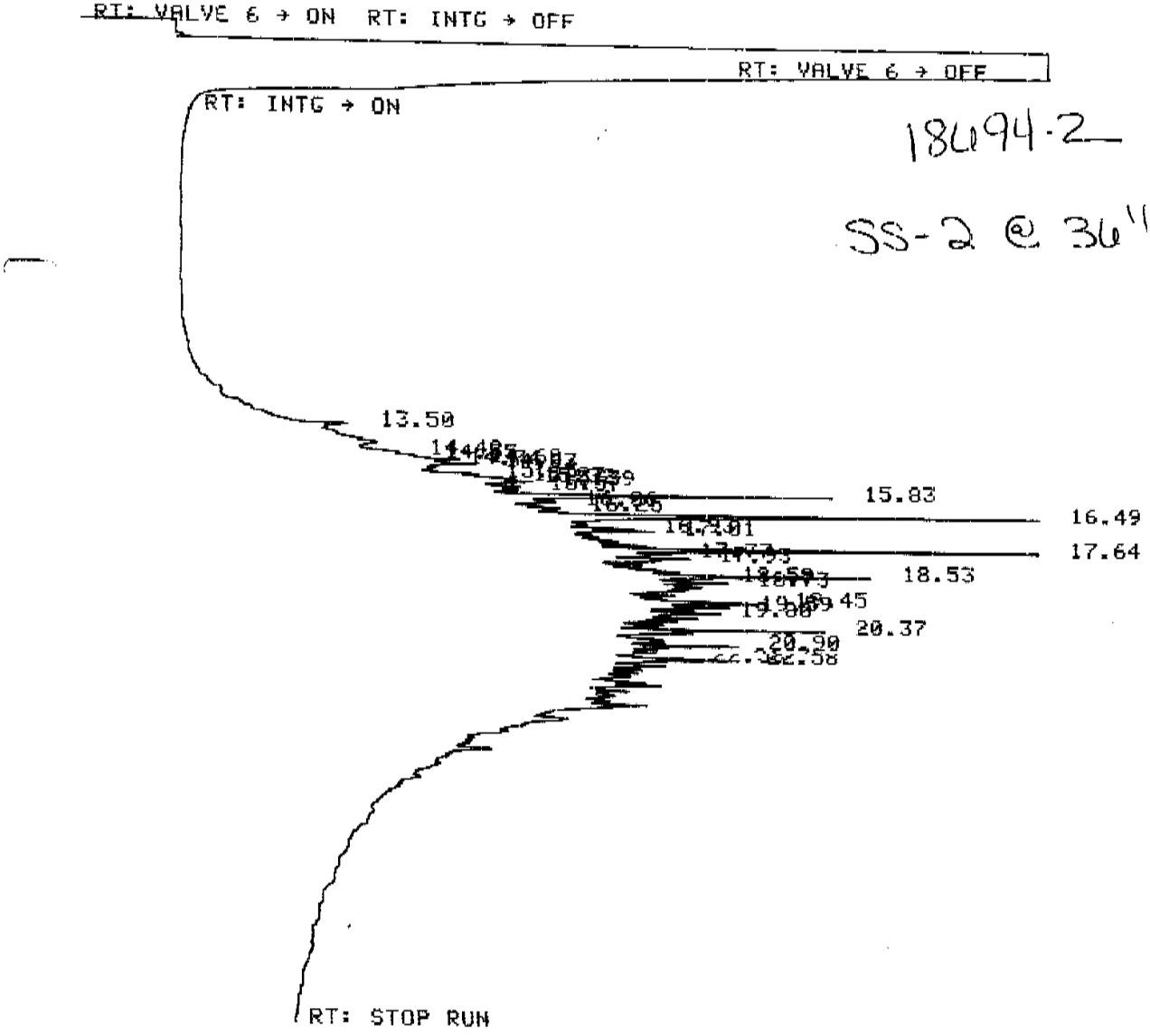


[hp] 5880A SAMPLER INJECTION @ 08:02 JUL 20, 2006
SAMPLE # : ID CODE :
24 694-1 1:100
AREA %

RT	AREA	TYPE	WIDTH	HEIGHT	BASELINE	AREA %
0.00			BASELINE @ START RUN = 29.92			
0.00			THRESHOLD @ START RUN = 4			
0.00			PEAK WIDTH @ START RUN = 0.04			
0.00			RT: INTG → OFF			
3.00			RT: INTG → ON			
3.00			RP: BL MODE → 2			
13.50	124.06	HH	-----	28.81	29.92	1.164
14.69	316.47	HH	-----	40.01	29.92	2.968
15.35	374.77	HH	-----	47.07	29.92	3.515
15.82	549.57	HH	-----*	70.92	29.92	5.155
16.48	1409.93	HH	-----*	128.36	29.92	13.225
17.01	374.83	HH	-----	60.15	29.92	3.516
17.63	1112.85	HH	*-----*	125.93	29.92	10.439
18.52	541.93	HH	-----	71.18	29.92	5.083
19.67	479.16	HH	-----	70.87	29.92	4.485

24.08	130.46	HH	-----	39.96	22.05	1.092
24.12	87.11	HH	-----	40.36	22.05	0.729
26.79	534.90	HH	-----	54.93	22.05	4.477

TOTAL AREA = 11948.90
MULTIPLIER = 1



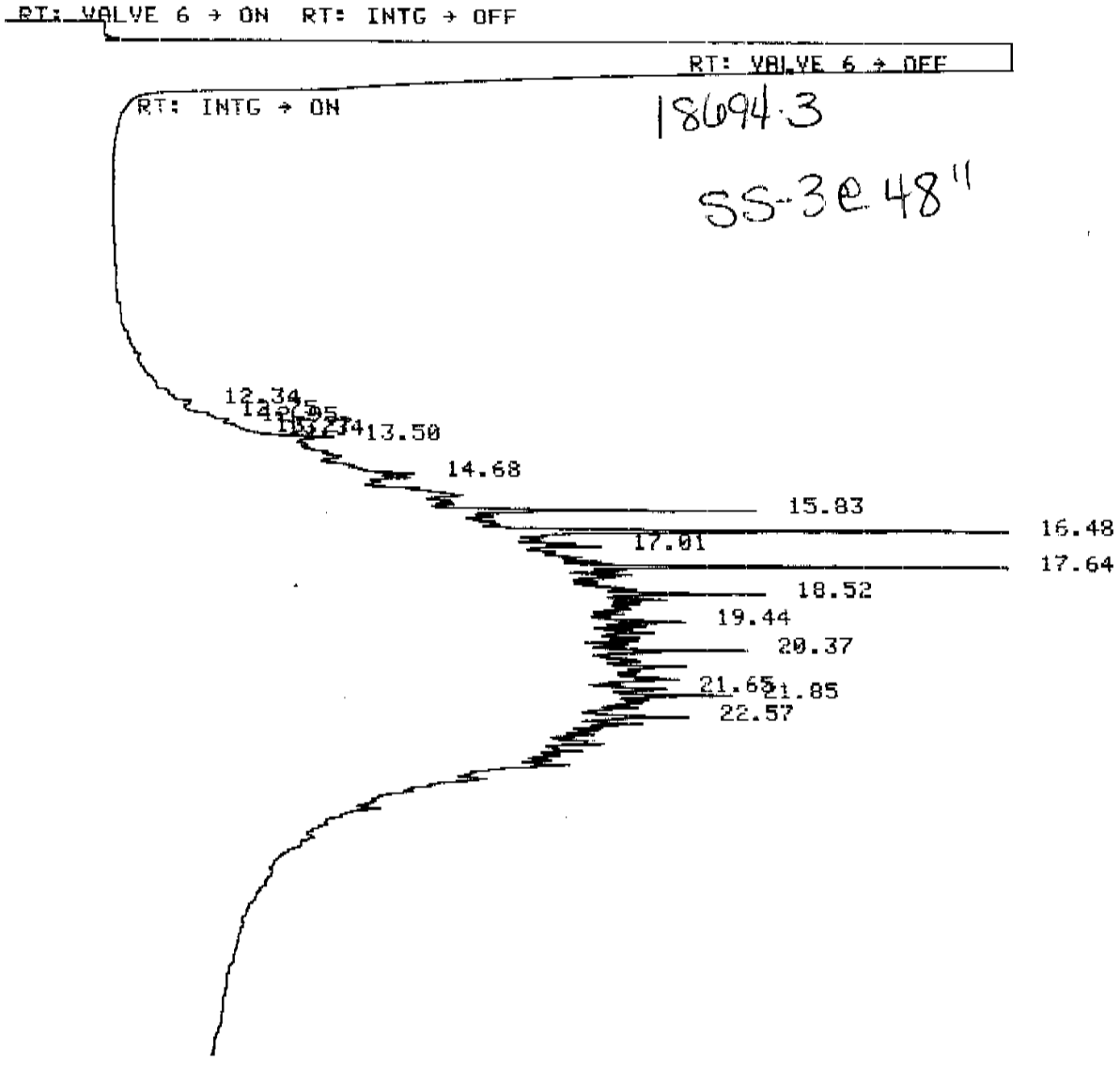
SAMPLE # : ID CODE :
29 694-2 1:50
AREA %

RT	AREA	TYPE	WIDTH	HEIGHT	BASELINE	AREA %
0.00						
0.00						
0.00						
0.00						
3.00						

BASELINE @ START RUN = 21.95
THRESHOLD @ START RUN = 4
PEAK WIDTH @ START RUN = 0.04
RT: INTG → OFF
RT: INTG → ON

16.93	380.56	HH	------	61.76	21.95	2.820
17.01	378.97	HH	------	64.61	21.95	2.808
17.64	1013.39	HH	------	147.58	21.95	7.508
17.77	252.48	HH	------	67.01	21.95	1.871
17.93	348.19	HH	------	69.45	21.95	2.580
18.53	668.00	HH	------	94.22	21.95	4.949
18.59	216.33	HH	------	72.61	21.95	1.603
18.73	423.81	HH	------	74.81	21.95	3.140
19.45	645.51	HH	------	79.83	21.95	4.783
19.59	469.42	HH	------	75.19	21.95	3.478
19.80	290.83	HH	------	72.55	21.95	2.155
20.37	605.54	HH	------	87.99	21.95	4.487
20.90	614.98	HH	------	76.40	21.95	4.557
21.35	592.35	HH	------	74.34	21.95	4.389
21.66	406.79	HH	------	70.15	21.95	3.014
21.86	492.78	HH	------	82.23	21.95	3.651
22.53	322.23	HH	------	68.95	21.95	2.387
22.58	381.56	HH	------	76.21	21.95	2.827

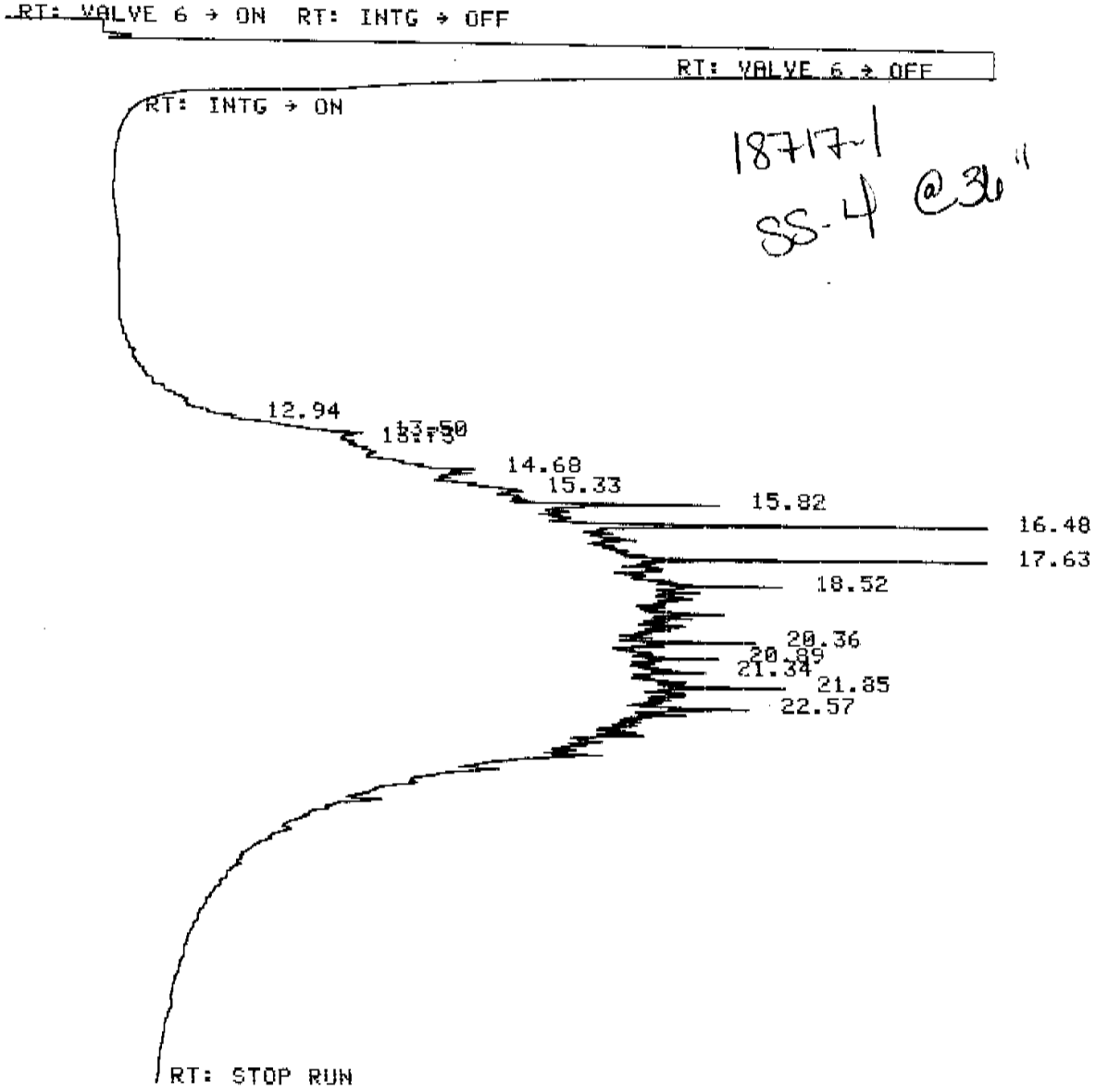
TOTAL AREA = 13496.70
MULTIPLIER = 1



RP: BL MODE → 2

12.50	816.15	HH	-----	226.43	18.54	45.215
12.53	988.89	HH	-----*	233.88	18.54	54.785

TOTAL AREA = 1805.04
MULTIPLIER = 1



[hp] 5880A SAMPLER INJECTION @ 16:31 JUL 26, 2006
SAMPLE # : ID CODE :
15 717-1 1:20
AREA %

RT	AREA	TYPE	WIDTH	HEIGHT	BASELINE	AREA %
0.00			BASELINE @ START RUN = 18.20			
0.00			THRESHOLD @ START RUN = 4			
0.00			PEAK WIDTH @ START RUN = 0.04			
0.00			RT: INTG → OFF			
3.00			RT: INTG → ON			
3.00			RP: BL MODE → 2			

ENVIROCOMPLIANCE LABORATORIES, INC.

816 Kiwanis Street
Hampton, Virginia 23661
Phone 804 · 244 · 3424
Fax 804 · 244 · 3243

Certificate of Analysis

MSA, P.C.
Attn: Charles Hall
5033 Rouse Drive
Virginia Beach, VA 23462

Project No. : 041543E
Project Name : New Kent- East Bound Rest Area
Date Received: July 21, 2006
Date Issued : July 27, 2006

Sample ID : SS-4 @36"

Parameter	Result	Units	DL	Date/Time Prepared	Date/Time Analyzed	Method	Analyst
TPH-DRO	1064.0	mg/kg	5.0	07-24/1110	07-26/0901	8015B	AEM

BDL = Below Detection Limit

Anamarie E. McKinley
Laboratory Manager

H6718717-1

APPENDIX C

Qualifications and Limitations

QUALIFICATIONS AND LIMITATIONS

MSA, P.C., is pleased to be of service in providing this Phase II Environmental Site Assessment. MSA warrants that neither the Company nor any of its employees have a financial interest in this project. Additionally, there is no conflict of interest between MSA and any of the parties attempting to purchase the property or obtain government regulatory approval for this project.

Our professional services have been performed, our findings obtained, and report prepared in accordance with customary principles and practices in the fields of environmental science and engineering. This warranty is in lieu of all other warranties either expressed or implied.

The scope of services performed in execution of this investigation may not be appropriate to satisfy the needs of others. This company is not responsible for the independent conclusions, opinions or recommendations made by others based on this report. The presented conclusions are a logical summation of the results obtained from the laboratory results and onsite investigations. Any use or re-use of this document and its findings, conclusions or recommendations is done so at the risk of said user. Any interpretations, qualifications or conclusions made through the use of this report must be verified and accepted by the author(s). This report cannot be copied without the written consent of the author(s).