COMMUNITY COLLEGE OF RHODE ISLAND

PROJECT MANUAL

Community College of Rhode Island
Knight Campus - 2nd Floor Laboratory Renovations
400 East Avenue / Warwick, Rhode Island

William Starck Architects, Inc.
126 Cove Street / Fall River, Massachusetts

Issue Date: November 7, 2019

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Owner:

State of Rhode Island

Acting by and through:

Department of Administration
Division of Purchases
One Capitol Hill, Second Floor
Providence, RI 02908
Phone: (401) 578-8100

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GENERAL

The drawings for this project represent an integral part of the contract documents, and should not be considered as a separate entity. They, along with the technical specifications, form a complete process of disseminating specific information required to perform the work of this project.

The following schedule indicates the drawings of this project, ordered for convenience only, and do not obligate the Contractor to perform the work in any specific sequence, nor construed as specific work for a specific trade, subcontractor or supplier.

GENERAL

Dwg. No	Drawing Title	Date
CS	Cover Sheet	Jan. 15, 2019
G1.1	General Notes & Code Information	Jan. 15, 2019

ARCHITECTURAL

Dwg. No	Drawing Title	Date
AD1.1	Demolition Floor Plan and Notes	Jan. 15, 2019
A1.1	Proposed Floor Plan	Jan. 15, 2019
A1.2	Proposed Finish Plan and Schedule	Jan. 15, 2019
A2.1	Proposed Reflected Ceiling Plan	Jan. 15, 2019
A3.1	Enlarged Plan and Elevations Classroom 2026	Jan. 15, 2019
A3.1a	Interior Elevation Classroom 2026	Jan. 15, 2019
A3.2	Enlarged Plan and Elevation Classroom 2028	Jan. 15, 2019
A3.3	Enlarged Plan and Elevations Eng. Storage 2030 & 2032	Jan. 15, 2019
A3.4	Enlarged Plan and Elevation Eng. Classroom 2034	Jan. 15, 2019
A3.4a	Interior Elevations Eng. Classroom 2034	Jan. 15, 2019
A3.5	Enlarged Plan & Elevations Computer/Science Lab 2036	Jan. 15, 2019
A3.6	Enlarged Plan and Elevation Physics Lab 2040	Jan. 15, 2019
A3.7	Interior Elevations Physics Lab 2040	Jan. 15, 2019
A3.8	Enlarged Plan and Elevations Physics Support 2042 & 2044	Jan. 15, 2019
A3.9	Enlarged Plan and Elevation Geology Lab 2046	Jan. 15,2019
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A3.11	Enlarged Plan and Elevations Astronomy Lab 2050	Jan. 15, 2019
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A3.13	Enlarged Plan I.T. Support 2056 & 2058	Jan. 15, 2019
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A3.15	Enlarged Plan and Elevations I.T. Staff 2064 & Cisco Resource 2062	Jan. 15, 2019
A3.16	Enlarged Plan and Elevation Cisco Classroom 2066	Jan. 15, 2019
A3.17	Enlarged Plan and Elevations Cisco Classroom 2067	Jan. 15, 2019
A4.1	Casework Schedule, Wall Types and Door Schedule	Jan. 15, 2019
A5.1	Interior Details	Jan. 15, 2019

PLUMBING

Dwg. No	Drawing Title	Date
P0.0	Plumbing Legend, Notes, Schedules & Details	Jan. 15, 2019
P1.0	Plumbing Demo Floor Plan	Jan. 15, 2019
P2.0	Plumbing New Work Floor Plan	Jan. 15, 2019

FIRE PROTECTION

Dwg. No	Drawing Title	Date
FP0.0	Fire Protection Legend, Narrative and Details	Jan. 15, 2019
FP1.0	Fire Protection Demo Floor Plan	Jan. 15, 2019
FP2.0	Fire Protection New Work Floor Plan	Jan. 15, 2019

MECHANICAL

Dwg. No	Drawing Title	Date
M0.0	HVAC Legend	Jan. 15, 2019
M1.0	HVAC Demo Plan	Jan. 15, 2019
M1.1	HVAC Renovation Plan	Jan. 15, 2019
M1.2	HVAC Renovation Plan - Piping	Jan. 15, 2019
M2.0	HVAC Schedules and Details	Jan. 15, 2019
M2.1	HVAC Details	Jan. 15, 2019

ELECTRICAL

Dwg. No	Drawing Title	Date
E0.1	Legend	Jan. 15, 2019
E0.2	Legend (Continued)	Jan. 15, 2019
ED1.1	Demolition Floor Plan - Lighting & Fire Alarm	Jan. 15, 2019
ED1.2	Demolition Floor Plan - Power & Telecom	Jan. 15, 2019
E1.1	Floor Plan - Lighting	Jan. 15, 2019

E2.1	Floor Plan - Power & Systems	Jan. 15, 2019
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E7.2	Schedules (Cont.)	Jan. 15, 2019
E8.1	Details	Jan. 15, 2019
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00 10 00 – SUPPLEMENT TO THE INSTRUCTIONS TO BIDDERS

Refer to the State Agency Solicitation provided by the State for Additional Instructions to Bidders.

END OF SECTION

00 30 00 – BID BOND AIA A310-2010

See AIA Document A310-2010, attached as the following page.

Refer to State Agency Solicitation provided by the State for additional Bid Bond requirements.

END OF SECTION

AIA® Document A310™ – 2010

Bid Bond

CONTRACTOR:
(Name, legal status and address)
TBD
TBD

SURETY:
(Name, legal status and principal place of business)
TBD
TBD

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

OWNER:
(Name, legal status and address)
TBD
TBD

BOND AMOUNT:

PROJECT:
(Name, location or address, and Project number, if any)
TBD
TBD

Project Number, if any:

The Contractor and Surety are bound to the Owner in the amount set forth above, for the payment of which the Contractor and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, as provided herein. The conditions of this Bond are such that if the Owner accepts the bid of the Contractor within the time specified in the bid documents, or within such time period as may be agreed to by the Owner and Contractor, and the Contractor either (1) enters into a contract with the Owner in accordance with the terms of such bid, and gives such bond or bonds as may be specified in the bidding or Contract Documents, with a surety admitted in the jurisdiction of the Project and otherwise acceptable to the Owner, for the faithful performance of such Contract and for the prompt payment of labor and material furnished in the prosecution thereof; or (2) pays to the Owner the difference, not to exceed the amount of this Bond, between the amount specified in said bid and such larger amount for which the Owner may in good faith contract with another party to perform the work covered by said bid, then this obligation shall be null and void, otherwise to remain in full force and effect. The Surety hereby waives any notice of an agreement between the Owner and Contractor to extend the time in which the Owner may accept the bid. Waiver of notice by the Surety shall not apply to any extension exceeding sixty (60) days in the aggregate beyond the time for acceptance of bids specified in the bid documents, and the Owner and Contractor shall obtain the Surety's consent for an extension beyond sixty (60) days.

If this Bond is issued in connection with a subcontractor's bid to a Contractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

When this Bond has been furnished to comply with a statutory or other legal requirement in the location of the Project, 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. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

Signed and sealed this day of

	(Principal)	*(Seal)*
(Witness)		
	(Title)	
	(Surety)	*(Seal)*
(Witness)		
	(Title)	

Init.

/

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00 31 00 – AVAILABLE INFORMATION

PART 1 - GENERAL

1.1 EXISTING CONDITIONS

A. Contractors to note presence of Hazardous Material at the work area. To aid the Contractor in identifying the specific areas of hazardous material contamination; the following report, of similar conditions found on the floor immediately above this project's work area (3rd floor) is contained herein following.

B. Contractor is to fully test as necessary in order to verify the true conditions of this project's work area as directed by the other pertinent sections of this Project Manual.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

00 31 02 – HAZARDOUS MATERIALS INSPECTION REPORT AND PROCEDURES

PART 1 - GENERAL

1.01 HAZARDOUS MATERIALS DISCOVERY

A. The Owner has determined that there are hazardous materials to be encountered under the work of this Project.
B. The Contractor is to include all costs for abatement in Base Bid price.

1.02 SECTION INCLUDES

A. The Contractor is required to provide testing to verify the presence of all potentially hazardous materials.

B. The Contractor shall prepare abatement plan(s) and submit to Rhode Island Dept. of Health.

C. The Prime Contractor shall be responsible for the removal and disposal of all hazardous-containing materials that have been found on the site. It is the intent of the Owner to have the Contractor remove and dispose all hazardous materials in full accordance with the Rhode Island Department of Health; Division of Occupational Health/Radiation Control and this Agency's issue "Rules and Regulation for Hazardous Materials Control", as amended to date.

"Invoices for removal and abatement shall be accompanied by approved shipping documents which describe final disposal location, date or disposal, approved signatures and General Contractor signature of acknowledgment."

1.03 RELATED WORK:

A. Documents affecting work of this section including but not necessarily limited to General Conditions, Supplementary Conditions, and sections in Division 1 of these Specifications.

1.04 RELATED REPORTS

A. Pertinent portions of applicable Survey and Sampling Reports produced for previous 3rd floor lab renovations are included herein, preceding this page.

1. CONTRACTOR NOTE WELL: Quantities, if applicable, are for reference only. The Contractor shall verify all quantities and assume all costs relative to the complete and proper removal and disposal of hazardous materials abatement.

1.05 ABATEMENT PROCEDURES (By the Contractor)

A. The Contractor shall obtain the services of a State-Certified Abatement Consultant to prepare an approved hazardous-materials abatement plan, monitoring and clearance samples.

B. Obtain the services of a State Certified Abatement Contractor to remove and dispose the hazardous materials in accordance with Federal, State and Local rules and regulations.

C. Retain hazardous materials abatement invoices for submittal with required close-out record documents. Invoices must be accompanied by complete shipping documents showing final disposal location.

D. A Pre-abatement Meeting with the Owner's Representative, the Prime Contractor, and the designated Abatement Contractor shall be held one (1) week prior to removal.

E. Provide other abatement related services not specifically described herein, but needed for a complete and proper job.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

Solicitation #:_____

Solicitation Title: CCRI - Knight Campus / 2nd Floor Lab Renovations

BID FORM

To: The Department of Administration, Division of Purchases
One Capitol Hill, Providence, RI 02908

Project: CCRI
Community College of Rhode Island
2nd Floor Lab Renovations

Bidder:

_____
Legal name of entity

_____
Address

_____
Contact name Contact email

_____
Contact telephone Contact fax

1. BASE BID PRICE

The Bidder submits this bid proposal to perform all of the work (including labor and materials) as described in the solicitation for this Base Bid Price, (including the costs for all Allowances, Bonds, and Addenda):

$ _____

(Base Bid Price *in figures* printed electronically, typed, or handwritten legibly in ink)

_____

(Base Bid Price *in words* electronically, typed, or handwritten legibly in ink)

Solicitation #:_____

Solicitation Title: CCRI - Knight Campus / 2nd Floor Lab Renovations

- **ALLOWANCES**

  The Base Bid Price ***includes*** the costs for the following Allowances:

  1. **Allowance #1: Unknown or Concealed Conditions - $50,000.00**
  2. **Allowance #2: Additional Interior Work as directed by CCRI - $40,000.00**
     Total Allowances: $90,000.00

- **BONDS**

  The Base Bid Price ***includes*** the costs for all Bid and Payment and Performance Bonds required by the solicitation.

- **ADDENDA**

  The Bidder has examined the entire solicitation (including the following Addenda), and the Base Bid Price ***includes*** the costs of any modifications required by the Addenda.

  All Addenda must be acknowledged.

  Addendum No. ____, dated _____
  Addendum No. ____, dated _____
  Addendum No. ____, dated _____
  Addendum No. ____, dated _____

2. ALTERNATES *(Additions to Base Bid Price)*

The Bidder offers to: (i) perform the work described in these Alternates as selected by the State in the order of priority specified below, based on the availability of funds and the best interest of the State; and (ii) increase the Base Bid Price by the amount set forth below for each Alternate selected.

N/A

3. UNIT PRICES

The Bidder submits these predetermined Unit Prices as the Basis for any change orders approved in advance by the State. These Unit Prices include ***all*** costs, including labor, materials, services, regulatory compliance, overhead, and profit.

N/A

Solicitation #:_____

Solicitation Title: CCRI - Knight Campus / 2nd Floor Lab Renovations

4. CONTRACT TIME

The Bidder offers to perform the work in accordance with the timeline specified below:

- Start of Submittals.....10 calendar days after receipt of CCRI PO

- Start of Construction ……..
- Substantial Completion ……
- Final Completion ……..

5. LIQUIDATED DAMAGES

The successful bidder awarded a contract pursuant to this solicitation shall be liable for and pay the State, as liquidated damages and not as a penalty, the following amount for ***each*** calendar day of delay beyond the date for substantial completion, as determined in the sole discretion of the State:

Two Hundred Fifty Dollars ($250.00) per day at each phase.

BID FORM SIGNATURE(S)

This bid proposal is irrevocable for 60 days from the bid proposal submission deadline.

If the Bidder is determined to be the successful bidder pursuant to this solicitation, the bidder will promptly: (i) comply with each of the requirements of the Tentative Letter of Award; and (ii) commence and diligently pursue the work upon issuance and receipt of the purchase order from the State and authorization from the user agency.

The person signing below certifies that he or she has been duly authorized to execute and submit this bid proposal on behalf of the Bidder.

BIDDER _____

Date: _____

_____
Name of Bidder

_____
Signature in ink

_____
Printed name and title of person signing on behalf of Bidder

_____
Bidder's Contractor Registration Number

00 50 00 – CONTRACTING FORMS

PART 1 - GENERAL

1.1 COPYRIGHT

A. Contractor is responsible for obtaining a valid license to use all copyrighted documents specified or included in the Project Manual.

1.2 AGREEMENT AND CONDITIONS OF THE CONTRACT

A. See Section 00 5200 for the Agreement form to be executed.

B. See Section 00 7200 for the General Conditions.

1.3 FORMS

A. Use the following forms for the specified purposes unless otherwise indicated elsewhere in the Contract Documents.

B. Bond Forms:

1. Performance Bond and Payment Bond Forms: AIA A312

C. Release of Lien:

1. Release of Liens Form: AIA G706A

D. Insurance certificate, supplementary attachment:

1. ACORD Certificate of Insurance Form: AIA G715

1.4 REFERENCE STANDARDS

A. AIA G706A – Release of Liens: 1994.

B. AIA A312 - Performance Bond: 2010 and Payment Bond: 2010.

C. AIA G715 – ACORD Certificate of Insurance: 1991.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

00 52 00 – AGREEMENT FORM

PART 1 - GENERAL

1.1 AGREEMENT FORM

A. The Agreement Form to be utilized on this project is AIA Document A101-2017 as amended, a copy of which follows this page.

END OF SECTION

Agency Conditions of Use:

I. **AIA contract templates are not to be edited, altered, revised or modified by the agency or vendors without the prior written approval of the Division of Legal Services (401/222-8880).**

II. **Agencies are responsible to ensure proper use of the appropriate AIA contract template(s) on State public works projects.**

DRAFT

AIA® Document A101™ – 2017

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101™–2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201™–2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

AGREEMENT made as of the « » day of « » in the year « »
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address, telephone and facsimile numbers, and website)

«State of Rhode Island, acting by and through the Department of Administration, Division of Purchases, on behalf of the User Agency»
«One Capitol Hill, Second Floor»
«Providence, Rhode Island 02908-5855»
«401.578.8100 (telephone); 401.574.8387 (facsimile)»
«www.ridop.ri.gov»

on behalf of the User Agency:
(Name, legal status, address, telephone and facsimile numbers, and website)

« »
« »
« »
« »
« »

and the Contractor:
(Name, legal status, address, telephone and facsimile numbers, and website)

« »
« »
« »
« »
« »

for the following Project:
(Name, location and detailed description)

« »
« »
« »

The Design Agent:
(Name, legal status, address, telephone and facsimile numbers, and website)

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User Notes: A101- 2017 template revision date 6/13/2019 (3B9ADA24)

« »
« »
« »
« »
« »

The Owner and Contractor agree as follows.

DRAFT

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User Notes: (3B9ADA24)

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4 CONTRACT SUM

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6 DISPUTE RESOLUTION

7 TERMINATION OR SUSPENSION

8 MISCELLANEOUS PROVISIONS

9 ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General Conditions, Supplementary Conditions (if any), and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others. No part of the Work shall be performed by Subcontractors without the Owner's prior written consent.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be the later of: (i) the issuance of the Purchase Order by the Owner; and (ii) the date set forth in a notice to proceed issued by the User Agency.

§ 3.2 The Contract Time shall be measured from the date of commencement of the Work.

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:
(Check one of the following boxes and complete the necessary information.)

[« »] Not later than « » (« ») calendar days from the date of commencement of the Work.

[« »] By the following date: « »

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

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User Notes: (3B9ADA24)

Portion of Work	Substantial Completion Date
« »	

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. Subject to additions and deductions as provided in the Contract Documents, the Contract Sum shall be: $_____.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price
« »	

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement.
(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)

Item	Price	Conditions for Acceptance
« »		

§ 4.3 Allowances, if any, are specified in the Bid Proposal Form and are included in the Contract Sum.

§ 4.4 Unit prices, if any, are specified in the Bid Proposal Form and include all costs, including without limitation, labor, materials, services, regulatory compliance, overhead, and profit necessary for the completion of the Work. Unit prices shall be used for both additions to, and deletions from the Work.

§ 4.5 Liquidated damages, if any:
(Insert terms and conditions for liquidated damages, if any.)

«**.1** In the event that there is one date for Substantial Completion of the Work, the Contractor shall pay the Owner the sum stipulated in this Section 4.5.1 as liquidated damages, and not as a penalty, for each calendar day of delay until the Work is substantially complete: $_____.

.2 In the event that the Project is scheduled to be completed in phases, and there is more than one date for Substantial Completion of the Work, the Contractor shall pay the Owner an aggregate amount equal to the sums stipulated in this Section 4.5.2 as liquidated damages, and not as a penalty, for each calendar day of delay until the Work for each phase is substantially complete:

Phase	Liquidated Damages Sum

.3 The Owner and the Contractor have reasonably determined the sums set forth in this Section 4.5 to be a fair estimate of the Owner' actual damages which are difficult to ascertain in the event of delay.»

§ 4.6 Other:

The Owner shall not be liable to the Contractor or any Subcontractor for claims or damages of any nature caused by or arising out of any delays. The sole remedy against the Owner for delays shall be the allowance of additional time for completion of the Work.

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ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Design Agent by the Contractor and Certificates for Payment issued by the Design Agent and approved by the Owner in writing, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month.

§ 5.1.3 The Owner shall make payment of the certified amount, less retainage, to the Contractor not later than the 30th working day following written approval by the Owner.

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor and approved by the Design Agent and the Owner in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Design Agent and the Owner may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 In accordance with AIA Document A201™–2007, General Conditions of the Contract for Construction as modified by the Owner, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

- **.1** That portion of the Contract Sum properly allocable to completed Work;
- **.2** That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and
- **.3** That portion of Construction Change Directives that the Design Agent determines, in the Design Agent's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

- **.1** The aggregate of any amounts previously paid by the Owner;
- **.2** The amount, if any, for Work that remains uncorrected and for which the Design Agent has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2007 as modified by the Owner;
- **.3** For Work performed or defects discovered since the last payment application, any amount for which the Design Agent may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2007 as modified by the Owner; and
- **.4** Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due: five (5%) percent.

§ 5.1.7.1.1 Deleted.

§ 5.1.7.2 Deleted.

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:

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The amount of five (5%) percent shall be retained by the Owner through the date of Substantial Completion of the Work and then after the date of Substantial Completion of the Work in accordance with R.I. Gen. Laws § 37-12-10.1.

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2007 as modified by the Owner.

§ 5.1.9 Except with the Owner's prior written approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.1.10 Within 10 working days of receipt of any progress payment from the Owner, the Contractor must pay its Subcontractors the full amount included for each such Subcontractor within the Contractor's Application for Payment in accordance with the provisions of AIA A201 – 2007, General Conditions of the Contract for Construction as modified by the Owner.

§ 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, less the amount withheld pursuant to § 5.1.7.3, shall be made by the Owner to the Contractor when:

- **.1** the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201–2007 as modified by the Owner, and to satisfy other requirements, if any, which extend beyond final payment; and
- **.2** a final Certificate for Payment has been issued by the Design Agent and approved in writing by the Owner;
- **.3** the Contractor has submitted its final release and final releases from all of its Subcontractors and suppliers in a form acceptable to the Owner; and
- **4** the Contractor has submitted to the Owner all close-out documents, including without limitation, all as-built plans, warranties, manuals, and other materials set forth in the Contract Documents.

§ 5.2.2 The Owner's final payment to the Contractor shall be made no later than 30 working days after the issuance of the Design Agent's final Certificate for Payment and written approval by the Owner.

§ 5.3 Interest

Payments due and unpaid under the Contract shall bear interest from the date payment is due in accordance with the provisions of "Prompt Payment by Department of Administration," R.I. Gen. Laws §§ 42-11.1-1 et seq.

§ 5.4 Owner's Rights

§ 5.4.1 The Owner shall have the right to deduct from any payments due to the Contractor the amount of any unpaid obligations owed to the State of Rhode Island by the Contractor, including without limitation, any and all unpaid taxes, the amount of any claim against the Contractor arising out of this Agreement, or any amount on account of any other reason permitted by applicable law.

§ 5.5 Pursuant to R.I. Gen. Laws § 44-1-6, the Owner shall withhold payment from the Contractor if the Contractor does not maintain a regular place of business in Rhode Island in the amount of three (3%) percent of the Contract Sum until 30 calendar days after Final Completion and compliance by the Contractor with the requirements of such section. The three (3%) percent withheld pursuant to R.I. Gen. Laws § 44-1-6 is not considered retainage which is held pursuant to § 5.1.7.

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

Claims shall be referred to the Initial Decision Maker for initial decision. The Purchasing Agent appointed pursuant to the provisions of the "State Purchases Act," R.I. Gen. Laws § 37-2-1 et seq., will serve as the Initial Decision Maker in accordance with the provisions of the State Purchases Act, State of Rhode Island Procurement Regulations, and this Section 6.1. An initial decision shall be required as a condition precedent to binding dispute resolution pursuant to Section 6.3 of any Claim arising prior to the date final payment is due.

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§ 6.2 Mediation

For any Claim not resolved by the Initial Decision Maker procedures set forth in Section 6.1, and prior to the implementation of the binding dispute resolution procedures set forth in Section 6.3, the Contractor shall have the option to pursue mediation, exercisable by written notice to the Owner within 30 calendar days of an Initial Decision. In the event of the exercise of such option by the Contractor, the Owner and the Contractor shall attempt to select a mediator, and in the event that the Owner and the Contractor cannot agree on a mediator, either party may apply in writing to the Presiding Justice of the Providence County Superior Court, with a copy to the other, with a request for the court to appoint a mediator, and the costs of the mediator shall be borne equally by both parties.

§ 6.3 Binding Dispute Resolution

For any Claim not resolved by the Initial Decision Maker procedures set forth in Section 6.1, or mediation at the option of the Contractor pursuant to Section 6.2, the method of binding dispute resolution shall be determined in accordance with the provisions of the "Public Works Arbitration Act," R.I. Gen. Laws §§ 37-16-1 et seq.

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2007, as modified by the Owner. The Contract may also be terminated by the Owner: (i) in the event of the unavailability of appropriated funds; (ii) in the absence of a determination of continued need; or (iii) as otherwise provided in the State of Rhode Island Procurement Regulations General Conditions of Purchase or other applicable law.

§ 7.1.1 Deleted.

§ 7.2 The Work may be suspended by the Owner as provided in: (i) the State of Rhode Island General Conditions of Purchase Regulation or other applicable law; or (ii) Article 14 of AIA Document A201–2007 as modified by the Owner.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2007 or another Contract Document, the reference refers to: (i) the AIA Document A201 – 2007 or other Contract Document as modified by the Owner; and (ii) that provision in the AIA Document A201 – 2007 as modified by the Owner or other Contract Document as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 Representatives for the Owner

§ 8.2.1 The Owner's representative:
(Name, title, address, email address, and other information for the preferred methods of contact)

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« »
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« »

§ 8.2.2 The User Agency's representative:
(Name, title, address, email address, and other information for the preferred methods of contact)

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§ 8.2.3 The Design Agent's representative:
(Name, title, address, email address, and other information for the preferred methods of contact)

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§ 8.3 The Contractor's representative:
(Name, title, address, email address, and other information for the preferred methods of contact)

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« »

§ 8.4 Neither the Owner's nor the Contractor's representative nor the Design Agent's representative shall be changed without 10 working days' prior notice to the other party.

§ 8.5 Insurance and Bonds
§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in the Solicitation and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in the Solicitation and elsewhere in the Contract Documents.

§ 8.6 Deleted.

§ 8.7 Other provisions:
§ 8.7.1 The Contractor represents and warrants to the Owner, in addition to any other representations and warranties of the Contractor elsewhere in the Contract Documents:

.1 The Contractor and its Subcontractors are each financially solvent, able to pay their debts as they mature, and possess sufficient working capital to perform their obligations under the Contract Documents.
.2 The Contractor and its Subcontractors are each able to furnish the tools, materials, equipment, and labor required to complete the Project as required under the Contract Documents.
.3 The Contractor and each Subcontractor are authorized to do business in the State of Rhode Island and are properly licensed by all necessary governmental authorities having jurisdiction over them and over the Work and the Project.
.4 The execution of this Agreement and its performance is within its duly authorized powers.
.5 The Contractor has visited the site of the Project, familiarized itself with the local and special conditions under which the Work is to be performed, and correlated its observations with the requirements of the Contract Documents.
.6 The Contractor possesses the requisite level of experience and expertise in the business administration, construction, and superintendence of projects of the size, complexity, and nature of the Project, and it will perform the Work with the care, skill, and diligence of a contractor possessing such experience and expertise.

§ 8.7.2 The representations and warranties of the Contractor in this Section 8.7 and elsewhere in the Contract Documents will survive the execution and delivery of this Agreement, any termination of this Agreement, and the final completion of the Work.

§ 8.7.3 Any Change Orders or other Modifications must be approved in writing by the Owner.

§ 8.7.4 The Owner is the State of Rhode Island, acting by and through its Department of Administration, Division of Purchases, and therefore, pursuant to the provisions of R.I. Gen. Laws § 34-28-31, mechanics liens may not be placed against the Project.

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ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

.1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor, as modified by the Owner

.2 **Deleted.**

.3 AIA Document A201™–2007, General Conditions of the Contract for Construction, as modified by the Owner.

.4 **Deleted.**

.5 Drawings

The Drawings are included in the Solicitation and are available on the Division of Purchases website at www.ridop.ri.gov.

.6 Specifications

The Specifications are included in the Solicitation and are available on the Division of Purchases website at www.ridop.ri.gov.

.7 Addenda, if any, issued pursuant to the Solicitation form a part of the Solicitation and are available on the Division of Purchases website at www.ridop.ri.gov.

.8 Supplementary and other Conditions of the Contract, including without limitation, the State of Rhode Island General Conditions of Purchase Regulation.

.9 Other documents listed below:

.1 The Solicitation, issued by the Owner, including without limitation, the Invitation to Bid, the Instructions to Bidders, the Specifications and Drawings, any Addenda, and the Bid Checklist.

.2 The Bid Proposal, including without limitation, the Bid Form and the Bidder Certification Cover Form.

.3 The Purchase Order issued by the Owner.

§ 9.2 This Agreement and the Contract Documents are subject to, and governed by, the laws of the State of Rhode Island, including all procurement statutes and regulations (available at www.ridop.ri.gov), and applicable federal and local law, all of which are fully incorporated into this Agreement by this reference.

§ 9.3 In the event of any conflict between or among the Contract Documents, or any Contract Documents and any provision of the State of Rhode Island Procurement Regulations and/or any other provision of the Rhode Island General Laws, the State of Rhode Island Procurement Regulations and the Rhode Island General Laws shall control.

ARTICLE 10 BENEFITS OF AGREEMENT

§ 10.1 The User Agency is a disclosed third-party beneficiary of this Agreement and shall have all of the rights and benefits hereunder to which such a party is entitled. Nothing contained in this Agreement shall create a contractual relationship with, or a cause of action in favor of, any other third party against the Owner or the User Agency.

§ 10.2 This Agreement shall be binding on the Contractor and its successors and assigns; provided, however, that the Contractor may not assign its rights nor delegate its responsibilities under this Agreement without the Owner's prior written consent.

This Agreement is entered into as of the day and year first written above; provided, however, that this Agreement shall not become a valid, binding, and enforceable contract unless and until the Owner shall have issued a Purchase Order.

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«THE STATE OF RHODE ISLAND, acting by and through its Department of Administration, Division of Purchases»	« »
OWNER *(Signature)*	**CONTRACTOR** *(Signature)*
« »« »	« »« »
(Printed name and title)	*(Printed name and title)*

DRAFT

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00 65 19 – WAIVER OF LIEN FORM

CCRI Document Waiver of Lien Form is included, following this page, as an integral part of the Contract documents. A copy with completed information must be submitted with the second and each succeeding Application for Payment.

COMMUNITY COLLEGE OF RHODE ISLAND

Department of Administration / Division of Purchases
One Capitol Hill, Second Floor; Providence, RI 02908

WAIVER OF LIEN FORM MATERIAL OR LABOR

Construction Project Title: _____

General Contractor: _____

Subcontractor/Supplier: _____

DUNS No.: _____

Application / Certificate for Payment No.: _____

Schedule of Values Line Item No.: _____

Description of Work Heading: _____

Total Payments Received, Including Current Payment: _____

The undersigned Representative of the above Subcontractor/Supplier has been contracted by the above General Contractor to furnish materials, or labor, or both, as included in the approved Schedule of Values under the Line Item No. and Description of Work Heading indicated above, for the Construction Project listed above.

The undersigned acknowledges receipt of payment, under this Line Item No. and Description of Work Heading, and hereby waives and releases any and all lien, or claim or right to lien, on the Construction Project listed above, and premises, under the statutes of the State of Rhode Island, relating to Mechanics Liens, on account of materials, or labor, or both, furnished, or which may be furnished, by the undersigned to, or on account of, the above numbered Application and Certificate for Payment.

Dated at this _____day of_____, 20____

Company: _____

Signature: _____

Printed Name: _____

Title: _____

END OF ATTACHMENT

00 72 00 – GENERAL CONDITIONS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

A. The General Conditions to be utilized on this project are AIA Document A201-2017 as amended, a copy of which follows this page.

END OF SECTION

Agency Conditions of Use:

I. **AIA contract templates are not to be edited, altered, revised or modified by the agency or vendors without the prior written approval of the Division of Legal Services (401/222-8880).**

II. **Agencies are responsible to ensure proper use of the appropriate AIA contract template(s) on State public works projects.**

DRAFT

AIA® Document A201™ – 2007

General Conditions of the Contract for Construction

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

for the following PROJECT:
(Name and location or address)

« »
« »

THE OWNER:
(Name, legal status and address)

The State of Rhode Island, acting by and through the Department of Administration
Division of Purchases, on behalf of the User Agency
One Capitol Hill, Second Floor
Providence, Rhode Island 02908-5855
(401) 574-8100 (telephone)
(401 574-8387 (facsimile)
www.ridop.ri.gov

THE USER AGENCY

(Name, address, telephone and facsimile numbers, and web address)

»« »
« »

THE Design Agent:
(Name, legal status, address, telephone and facsimile numbers, and web address)

« »« »
« »

TABLE OF ARTICLES

1 GENERAL PROVISIONS

2 OWNER

3 CONTRACTOR

4 DESIGN AGENT

5 SUBCONTRACTORS

6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

7 CHANGES IN THE WORK

8 TIME

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9 PAYMENTS AND COMPLETION

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14 TERMINATION OR SUSPENSION OF THE CONTRACT

15 CLAIMS AND DISPUTES

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 BASIC DEFINITIONS

§ 1.1.1 THE CONTRACT DOCUMENTS

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (the Agreement) and consist of the Agreement (and the documents enumerated therein), Conditions of the Contract (General Conditions, Supplementary Conditions, if any, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive or (4) a written order for a minor change in the Work issued by the Design Agent.

§ 1.1.2 THE CONTRACT

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Design Agent or the Design Agent's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Design Agent or the Design Agent's consultants or (4) between any persons or entities other than the Owner and the Contractor. The Design Agent shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Design Agent's duties.

§ 1.1.3 THE WORK

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 THE PROJECT

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by separate contractors.

§ 1.1.5 THE DRAWINGS

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location, and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 THE SPECIFICATIONS

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 INSTRUMENTS OF SERVICE

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Design Agent and the Design Agent's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 INITIAL DECISION MAKER

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2 and certify termination of the Agreement under Section 14.2.2.

§ 1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

§ 1.2.1 The intent of the Contract Documents is to include all items and services necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; the Contractor shall perform all work reasonably inferable from the Contract Documents as being necessary to produce the indicated results.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

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§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.2.4 In the event of any conflicts or discrepancies among the Contract Documents, the provisions of the Contract Documents will be interpreted in the following order of priority:

.1 Written modifications (if any).
.2 The Purchase Order.
.3 The AIA Documents, as modified by the Owner.
.4 The Supplementary Conditions (if any).
.5 The Bid Proposal.
.6 The Solicitation, including any Addenda, and the Specifications and Drawings

§ 1.2.5 In the event of any conflicts or discrepancies between the Contract Documents and the State of Rhode Island Procurement Regulations or any provision of the Rhode Island General Laws, the State of Rhode Island Procurement Regulations and the Rhode Island General Laws will control.

§ 1.2.6 In the event of any inconsistency between the Drawings and Specifications, the better quality or greater quantity of Work shall be provided.

§ 1.2.7 The Owner will be the final decision maker for any and all interpretations.

§ 1.3 CAPITALIZATION

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 INTERPRETATION

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE

§ 1.5.1 The Owner and the User Agency shall have a perpetual license to utilize the Drawings, Specifications, and other documents, including electronic or digital documents, prepared by the Design Agent and the Design Agent's consultants, for the execution of the Project and shall have and retain all rights to use them and reproduce them for the production and maintenance of the Work described therein. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Design Agent's or Design Agent's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce the Instruments of Service provided to them solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers may not use the Instruments of Service on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Design Agent and the Design Agent's consultants.

§ 1.6 TRANSMISSION OF DATA IN DIGITAL FORM

If the parties intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmissions, unless otherwise already provided in the Agreement or the Contract Documents.

ARTICLE 2 OWNER

§ 2.1 GENERAL

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as

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otherwise provided in Section 4.2.1, the Design Agent does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 Deleted.

§ 2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

§ 2.2.1 Deleted.

§ 2.2.2 The Contractor shall secure and pay for permits and fees, necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.2.3 If required for the Work in the discretion of the Owner, the Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of any information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.2.4 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.2.5 Deleted.

§ 2.3 OWNER'S RIGHT TO STOP THE WORK

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.4 OWNER'S RIGHT TO CARRY OUT THE WORK

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a 10 working-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such deficiencies. In such case an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Design Agent's additional services made necessary by such default, neglect, or failure. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Design Agent. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

ARTICLE 3 CONTRACTOR

§ 3.1 GENERAL

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Design Agent, or by tests, inspections, or approvals required or performed by persons or entities other than the Contractor.

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§ 3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.2.3, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Owner and the Design Agent any errors, inconsistencies, or omissions discovered by or made known to the Contractor or additional Drawings, Specifications, or instructions required to define the Work in greater detail to permit the proper progress of the Work as a request for information in such form as the Design Agent may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Design Agent and the Owner any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Design Agent or Owner may require.

§ 3.2.3.1 Omissions from the Drawings and Specifications of items obviously needed to perform the Work properly, such as attachments, bolts, hangers, and other fastening devices, shall not relieve the Contractor from the obligation to furnish and install such items.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Design Agent issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall make Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2, 3.2.3, or 3.2.3.1, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Design Agent for damages resulting from errors, inconsistencies, or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.2.4.1 The Contractor shall not make any changes without prior written authorization from the Design Agent and the Owner.

§ 3.2.5 The Owner is entitled to reimbursement from the Contractor for amounts paid to the Design Agent for evaluating and responding to the Contractor's requests for information that are not prepared in accordance with the Contract Documents or where the requested information is available to the Contractor from a careful study and comparison of the Contract Documents, field conditions, other Owner-provided information, Contractor-prepared coordination drawings, or prior Project correspondence or documentation.

§ 3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall evaluate the jobsite safety thereof and, except as stated below, shall be fully and solely responsible for the jobsite safety of such means, methods, techniques, sequences or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to the Owner and Design Agent and shall not proceed with that portion of the Work without further written instructions from the Design Agent. If the Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without

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acceptance of changes proposed by the Contractor, the Owner shall be solely responsible for any loss or damage arising solely from those Owner-required means, methods, techniques, sequences or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 LABOR AND MATERIALS

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work. Whenever the Contractor has an obligation to provide labor and materials under the Agreement, the Contractor, at a minimum, shall provide the labor for, and furnish and install and place in operation all items, including without limitation, all proper connections.

§ 3.4.2 Except in the case of minor changes in the Work authorized by the Design Agent in accordance with Sections 3.12.8 or 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Design Agent and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 WARRANTY

The Contractor warrants to the Owner and the Design Agent that materials and equipment furnished under the Contract will be of first quality, prime manufacture, and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements, including substitutions not properly authorized, may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Design Agent, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.6 TAXES

§ 3.6.1 The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.6.2 The State of Rhode Island is exempt from payment of any federal or state excise, transportation, or sales tax. The Rhode Island Department of Administration Division of Purchases will furnish Exemption Certificates upon request.

§ 3.7 PERMITS, FEES, NOTICES AND COMPLIANCE WITH LAWS

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections required by the Rhode Island State Building Code necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded. The Contractor shall be responsible for obtaining the Certificate of Occupancy from the appropriate governmental authorities.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

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§ 3.7.3 The Contractor shall promptly notify the Design Agent and the Owner if the Contractor becomes aware that the Contract Documents are not in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities. If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions. If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature, that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Design Agent before conditions are disturbed and in no event later than 21 working days after first observance of the conditions. The Design Agent will promptly investigate such conditions and, if the Design Agent determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend an equitable adjustment in the Contract Sum or Contract Time, or both. If the Design Agent determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Design Agent shall promptly notify the Owner and Contractor in writing, stating the reasons. If either party disputes the Design Agent's determination or recommendation, that party may proceed as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Design Agent. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 ALLOWANCES

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- **.1** Allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- **.2** Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- **.3** Whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 SUPERINTENDENT

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Design Agent the name and qualifications of a proposed superintendent. The Design Agent may reply within 14 working days to the Contractor in writing stating (1) whether the Owner or the Design Agent has reasonable objection to the proposed superintendent or (2) that the Design Agent requires additional time to review. Failure of the Design Agent to reply within the 14 working-day period shall constitute notice of no reasonable objection.

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§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Design Agent has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 CONTRACTOR'S CONSTRUCTION SCHEDULES

§ 3.10.1 The Contractor, within 20 working days after the issuance of the Purchase Order, shall prepare and submit for the Owner's and Design Agent's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals, not less frequently than monthly, as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work. The Contractor shall certify on the initial schedule and all revised schedules that they comply with the Contract Documents.

§ 3.10.2 The Contractor shall prepare a submittal schedule, within 20 working days after the issuance of the Purchase Order, and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Owner's and the Design Agent's approval. The Owner's and the Design Agent's approval shall not unreasonably be delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Owner and the Design Agent reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Design Agent.

§ 3.11 DOCUMENTS AND SAMPLES AT THE SITE

The Contractor shall maintain at the site for the Owner one copy of the Drawings, Specifications, Addenda, Change Orders and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and one copy of approved Shop Drawings, Product Data, Samples and similar required submittals. These shall be available to the Design Agent and shall be delivered to the Design Agent for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents. Their purpose is to demonstrate the way by which the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Design Agent is subject to the limitations of Section 4.2.7. Informational submittals upon which the Design Agent is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Design Agent without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve and submit to the Design Agent Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents in accordance with the submittal schedule approved by the Owner and the Design Agent or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of separate contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents to the Owner and Design Agent that the Contractor has (1) reviewed and approved them, (2) determined and verified

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materials, field measurements and field construction criteria related thereto, or will do so and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been approved by the Design Agent.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Design Agent's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Design Agent in writing of such deviation at the time of submittal and (1) the Design Agent has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Design Agent's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Design Agent on previous submittals. In the absence of such written notice, the Design Agent's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. The Contractor shall not be required to provide professional services in violation of applicable law. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Design Agent will specify all performance and design criteria that such services must satisfy. The Contractor shall cause such services or certifications to be provided by a properly licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Design Agent. The Owner and the Design Agent shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Design Agent have specified to the Contractor all performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Design Agent will review, approve, or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Contractor shall not be responsible for the adequacy of the performance and design criteria specified in the Contract Documents.

§ 3.12.11 The Owner shall be entitled to reimbursement from the Contractor for amounts paid to the Design Agent for evaluation of resubmittals.

§ 3.13 USE OF SITE

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, and any restrictions imposed by the User Agency or the Owner, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 CUTTING AND PATCHING

§ 3.14.1 The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting and patching shall be restored to the condition existing prior to the cutting, fitting and patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably

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withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

§ 3.15 CLEANING UP

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 ACCESS TO WORK

The Contractor shall provide the Owner and Design Agent access to the Work in preparation and progress wherever located.

§ 3.17 ROYALTIES, PATENTS AND COPYRIGHTS

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Design Agent harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner or Design Agent. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Design Agent and the Owner.

§ 3.18 INDEMNIFICATION

§ 3.18.1 To the fullest extent permitted by law the Contractor shall indemnify and hold harmless the Owner, the State of Rhode Island, its elected and appointed officials, members, employees, and agents, the Design Agent, the Design Agent's Consultants, Subconsultants, and Subcontractors, and agents and employees and any of them from and against any and all claims, demands, damages, liabilities, judgments, losses and expenses, including but not limited to reasonable attorneys' fees and costs of mediation, arbitration, and/or litigation, arising out of or resulting from performance of the Work, and/or the obligations of the under the Contract Documents, but only to the extent caused by willful misconduct and/or negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not any such claim, demand, damage, liability, judgment, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

§ 3.18.3 Without limiting the generality of the foregoing, the defense and indemnity set forth in this Section 3.18 includes, without limitation, all liabilities, damages, losses, claims, demands, and actions on account of bodily injury, death, or property loss to a person or entity indemnified hereunder or any other persons or entities, whether based upon statutory (including, without limitation, workers compensation), contractual, tort, or other liability of any person or entity so indemnified.

§ 3.18.4 The remedies set forth herein shall not deprive any person indemnified hereunder of any other indemnity action, right, or remedy otherwise available to any such person or entity at common law or otherwise.

§ 3.18.5 The Contractor will include the indemnity set forth in this Section 3.18, without modification, in each Subcontract with any Subcontractor.

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§ 3.18.6 Notwithstanding any other language in the Contract Documents to the contrary, the indemnity hereunder shall survive Final Completion of the Work and final payment under the Agreement and shall survive any termination of the Agreement.

ARTICLE 4 DESIGN AGENT

§ 4.1 GENERAL

§ 4.1.1 The Design Agent is the person lawfully licensed to practice his or her profession in the State of Rhode Island or an entity lawfully practicing its profession in the State of Rhode Island and identified in the Contract Documents as the Design Agent. The term "Design Agent" means the Design Agent or the Design Agent's authorized representative.

§ 4.1.2 Duties, responsibilities and limitations of authority of the Design Agent as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner, Contractor and Design Agent. Consent shall not be unreasonably withheld.

§ 4.1.3 If the employment of the Design Agent is terminated, the Owner shall employ a successor Design Agent as to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Design Agent.

§ 4.2 ADMINISTRATION OF THE CONTRACT

§ 4.2.1 The Owner with assistance from the Design Agent will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction through the date the Design Agent issues the final Certificate for Payment and continuing until the expiration of the one-year period following Final Completion. The Design Agent will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Design Agent will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Design Agent will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Design Agent will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents, except as provided in Section 3.3.1.

§ 4.2.2.1 The Owner is entitled to reimbursement from the Contractor for amounts paid to the Design Agent for site visits made necessary by the fault of the Contractor or by defects and deficiencies in the Work.

§ 4.2.3 On the basis of the site visits, the Design Agent will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work. The Design Agent will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Design Agent will not have control over or charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 COMMUNICATIONS FACILITATING CONTRACT ADMINISTRATION

Except as otherwise provided in the Contract Documents or when direct communications have been specially authorized, the Owner and Contractor shall endeavor to communicate with each other through the Design Agent about matters arising out of or relating to the Contract. Communications by and with the Design Agent's consultants shall be through the Design Agent. Communications by and with Subcontractors and material suppliers shall be through the Contractor. Communications by and with separate contractors shall be through the Owner.

§ 4.2.5 Based on the Design Agent's evaluations of the Contractor's Applications for Payment, the Design Agent will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Design Agent has authority to reject Work that does not conform to the Contract Documents. Whenever the Design Agent considers it necessary or advisable, the Design Agent will have authority to require inspection or

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testing of the Work in accordance with Sections 13.5.2 and 13.5.3, whether or not such Work is fabricated, installed or completed. However, neither this authority of the Design Agent nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Design Agent to the Contractor, Subcontractors, material and equipment suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Design Agent will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Design Agent's action will be taken in accordance with the submittal schedule approved by the Design Agent or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Design Agent's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Design Agent's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5 and 3.12. The Design Agent's review shall not constitute approval of safety precautions or, unless otherwise specifically stated by the Design Agent, of any construction means, methods, techniques, sequences or procedures. The Design Agent's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Design Agent will prepare Change Orders and Construction Change Directives, and may authorize minor changes in the Work as provided in Section 7.4. The Design Agent will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Design Agent will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Design Agent agree, the Design Agent will provide one or more project representatives to assist in carrying out the Design Agent's responsibilities at the site. The duties, responsibilities and limitations of authority of such project representatives shall be as set forth in an exhibit to be incorporated in the Contract Documents.

§ 4.2.11 The Design Agent will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Design Agent's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Design Agent will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Design Agent will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Design Agent's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents and approved by the Owner.

§ 4.2.14 The Design Agent will review and respond to requests for information about the Contract Documents. The Design Agent's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Design Agent will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 DEFINITIONS

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number

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and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a separate contractor or subcontractors of a separate contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

§ 5.2.1 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner and the Design Agent the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) proposed for each portion of the Work. The Owner may reply within 14 working days to the Contractor in writing stating (1) whether the Owner or the Design Agent has reasonable objection to any such proposed person or entity or (2) that the Owner or Design Agent requires additional time for review.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Design Agent has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Design Agent has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Design Agent has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person or entity previously selected if the Owner or Design Agent makes reasonable objection to such substitution.

§ 5.2.5 MANUFACTURERS AND FABRICATORS

§ 5.2.5.1 Not later than 10 working days after the date of commencement of the Work, the Contractor shall furnish in writing to the Owner and the Design Agent the names of the manufacturers or fabricators for certain products, equipment, and systems identified in the Specifications and, where applicable, the name of the installing Subcontractor. The Owner may reply within 14 working days to the Contractor in writing, stating: (i) whether the Owner or the Design Agent has reasonable objection to any such proposed person manufacturer or fabricator; or (ii) whether the Owner or Design Agent requires additional time to review.

§ 5.2.5.2 The Contractor shall not contract with a proposed manufacturer, fabricator, or Subcontractor to whom the Owner or Design Agent has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.5.3 If the Owner or Design Agent has an objection to a manufacturer, fabricator, or Subcontractor proposed by the Contractor, the Contractor shall propose another to whom the Owner or Design Agent has no objection.

§ 5.2.5.4 The Contractor shall not substitute a manufacturer, fabricator, or Subcontractor previously selected if the Owner or Design Agent makes reasonable objection to such substitution.

§ 5.3 SUBCONTRACTUAL RELATIONS

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by these Documents, assumes toward the Owner and Design Agent. Upon the request of the User Agency and/or the Owner, the Contractor shall provide the User Agency and/or the Owner with copies of each subcontract agreement. Each subcontract agreement shall preserve and protect the rights of the Owner and Design Agent under the Contract Documents with respect to the Work to be performed by the

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Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 CONTINGENT ASSIGNMENT OF SUBCONTRACTS

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- **.1** assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor in writing; and
- **.2** assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 working days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon such assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 OWNER'S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS

§ 6.1.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under Conditions of the Contract identical or substantially similar to these including those portions related to insurance and waiver of subrogation.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each separate contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with other separate contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to the construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, separate contractors and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces, the Owner shall be deemed to be subject to the same obligations and to have the same rights that apply to the Contractor under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6 and Articles 10, 11 and 12.

§ 6.2 MUTUAL RESPONSIBILITY

§ 6.2.1 The Contractor shall afford the Owner and separate contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a separate contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly report to the Design Agent apparent discrepancies or defects in such other construction that would render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acknowledgment that the

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Owner's or separate contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work, except as to defects not then reasonably discoverable.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a separate contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a separate contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or separate contractors as provided in Section 10.2.5.

§ 6.2.5 The Owner and each separate contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 OWNER'S RIGHT TO CLEAN UP

If a dispute arises among the Contractor, separate contractors and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 GENERAL

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement between the Owner and the Contractor; a Construction Change Directive requires agreement by the Owner and may or may not be agreed to by the Contractor; an order for a minor change in the Work may be issued by the Design Agent alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents, and the Contractor shall proceed promptly, unless otherwise provided in the Change Order, Construction Change Directive or order for a minor change in the Work.

§ 7.2 CHANGE ORDERS

§ 7.2.1 A Change Order is a written instrument prepared by the Contractor and signed by the Owner, Contractor and Design Agent stating their agreement upon all of the following:

- **.1** The change in the Work;
- **.2** The amount of the adjustment, if any, in the Contract Sum; and
- **.3** The extent of the adjustment, if any, in the Contract Time.

§ 7.2.2 Subsequent to the approval of a Change Order as provided in § 7.1.2, whether such Change Order changes the Contract Sum or Contract Time or both, no additional claim related to such Change Order will be considered by the Owner. Any change, once incorporated into a Change Order, is all inclusive, and includes all factors that could have been considered at the time of the Change Order such as Project impact or schedule "ripple" effect.

§ 7.3 CONSTRUCTION CHANGE DIRECTIVES

§ 7.3.1 A Construction Change Directive is a written order prepared by the Design Agent and signed by the Owner, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

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.1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
.2 Unit prices stated in the Contract Documents or subsequently agreed upon;
.3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
.4 As provided in Section 7.3.7.

§ 7.3.4 Deleted.

§ 7.3.5 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Design Agent of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.6 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.7 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Design Agent shall determine the method and the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in Section 7.3.1. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Design Agent may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.7 shall be limited to the following:
.1 Costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance;
.2 Costs of materials, supplies and equipment, including cost of delivery;
.3 Rental costs of machinery and equipment, exclusive of hand tools; or
.4 Costs of premiums for all bonds and insurance and permit fees related to the Work..

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Design Agent. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Design Agent will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Design Agent determines, in the Design Agent's professional judgment, to be reasonably justified. The Design Agent's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Design Agent concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Contractor will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.3.11 The combined overhead and profit included in the total cost to the Owner for a change in the Work shall be based on the following schedule:
.1 For the Contractor, for work performed by the Contractor's own forces, an amount not to exceed ten (10%) percent of the cost.
.2 For the Contractor, for work performed by the Contractor's Subcontractors, an amount not to exceed five (5%) of the amount due to the Subcontractors.
.3 For each Subcontractor, for work performed by the Subcontractor's own forces, an amount not to exceed ten (10%) percent of the cost.

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.4 Where the Work represents both additions and deletions and results in a net increase, the allowable overhead and profit shall be in accordance with this Section 7.3.11, but in no event shall the amount exceed fifteen (15%) percent of the net increase in the cost of the Work.

§ 7.3.12 All proposals with an aggregate cost equal to or in excess of $500.00 shall be accompanied by a detailed itemization of costs, including labor, materials (quantities and prices), and Subcontracts, in a form acceptable to the Owner. In no event will a change order request reflecting an aggregate cost equal to or in excess of $500.00 be approved without such itemization.

§ 7.4 MINOR CHANGES IN THE WORK

The Design Agent with the prior written approval of the Owner has authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes will be affected by written order signed by the Design Agent and shall be binding on the Owner and Contractor.

ARTICLE 8 TIME

§ 8.1 DEFINITIONS

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

The date of commencement of the Work is the date established in Section 3.1 of the Agreement..

§ 8.1.3 The date of Substantial Completion is the date certified by the Design Agent in accordance with Section 9.8.

§ 8.1.4 Deleted.

§ 8.2 PROGRESS AND COMPLETION

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance required by Article 11 to be furnished by the Contractor and Owner. The date of commencement of the Work shall not be changed by the effective date of such insurance.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 DELAYS AND EXTENSIONS OF TIME

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by an act or neglect of the Owner or Design Agent, or of an employee of either, or of a separate contractor employed by the Owner; or by changes ordered in the Work; or by labor disputes, fire, unusual delay in deliveries, unavoidable casualties or other causes beyond the Contractor's control, then the Contract Time shall be extended by Change Order for such reasonable time as the Owner may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 CONTRACT SUM

The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

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§ 9.2 SCHEDULE OF VALUES

Within 20 working days of the issuance of the Purchase Order, and promptly if revision is necessary from time to time as a result of a Change Order, the Contractor shall submit to the Owner, before the first Application for Payment, a schedule of values allocating the entire Contract Sum to the various portions of the Work and prepared in such form and supported by such data to substantiate its accuracy as the Design Agent and the Owner may require. This schedule, if and when approved by the Design Agent and the Owner in writing, shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 9.3 APPLICATIONS FOR PAYMENT

§ 9.3.1 At least 10 working days before the date established for each progress payment, the Contractor shall submit to the Design Agent and the Owner for approval an itemized Application for Payment prepared in accordance with the schedule of values for completed portions of the Work. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or the Design Agent may require, such as copies of requisitions from Subcontractors and material suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 All Applications for Payment for Change Orders must be accompanied by a Notice of Change in Purchase Order issued by the Owner, and if directed by the Owner, by the User Agency.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or material supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.1.3 The form of Application for Payment shall be AIA Document G702, Application and Certification for Payment, supported by AIA Document G702A, Continuation Sheet.

§ 9.3.1.4 Until Substantial Completion, the Owner shall pay ninety-five (95%) percent of the amount due the Contract on account of progress payments.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage and transportation to the site for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall be free and clear of liens, claims, security interests or encumbrances in favor of the Contractor, Subcontractors, material suppliers, or other persons or entities making a claim by reason of having provided labor, materials and equipment relating to the Work. The Contractor shall immediately satisfy any lien, claim, or encumbrance against the site where the Project is located and indemnify the Owner from and against all resulting costs and expenses, including without limitation, attorneys' fees.

§ 9.4 CERTIFICATES FOR PAYMENT

§ 9.4.1 The Design Agent will, within 7 working days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Design Agent determines is properly due, or notify the Contractor and Owner in writing of the Design Agent's reasons for withholding certification in whole or in part as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Design Agent to the Owner, based on the Design Agent's evaluation of the Work and the data comprising the Application for Payment, that, the Work has progressed to the point indicated and that the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor

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deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Design Agent. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Design Agent has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment, or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.4.3 The Contractor must submit all product literature, material and color samples with each Application for Payment, or as otherwise required by the Owner.

§ 9.5 DECISIONS TO WITHHOLD CERTIFICATION

§ 9.5.1 The Design Agent will withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Design Agent's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Design Agent is unable to certify payment in the amount of the Application, the Design Agent will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Design Agent cannot agree on a revised amount, the Design Agent will promptly issue a Certificate for Payment for the amount for which the Design Agent is able to make such representations to the Owner. The Design Agent may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Design Agent's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of:

- **.1** defective Work not remedied;
- **.2** third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;
- **.3** failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
- **.4** reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- **.5** damage to the Owner or a separate contractor;
- **.6** reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;
- **.7** failure to carry out the Work in accordance with the Contract Documents; or
- **.8** any other failure to comply with the obligations of the Contractor under the Contract Documents.

§ 9.5.2 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.3 The Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or material or equipment suppliers to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Design Agent and the Design Agent will reflect such payment on the next Certificate for Payment.

§ 9.6 PROGRESS PAYMENTS

§ 9.6.1 After the Design Agent has issued a Certificate for Payment and the Owner has approved the Certificate for Payment in writing, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Design Agent.

§ 9.6.2 The Contractor shall pay each Subcontractor no later than 10 working days after receipt of payment from the Owner the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Design Agent will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Design Agent and Owner on account of portions of the Work done by such Subcontractor.

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§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and material and equipment suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within 7 working days, the Owner shall have the right to contact Subcontractors to ascertain whether they have been properly paid. The Owner shall have the right to withhold payment(s) to the Contractor in the event that any Subcontractors or material and equipment suppliers have not been properly paid. Neither the Owner nor Design Agent shall have an obligation to pay or to see to the payment of money to a Subcontractor, except as may otherwise be required by law.

§ 9.6.5 Contractor payments to material and equipment suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors and suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, shall create any fiduciary liability or tort liability on the part of the Contractor for breach of trust or shall entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.7 FAILURE OF PAYMENT

If the Design Agent does not issue a Certificate for Payment, through no fault of the Contractor, within 7 working days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within 7 working days after the date established in the Contract Documents the amount certified by the Design Agent or awarded by binding dispute resolution, then the Contractor may, upon 7 additional working days' written notice to the Owner and Design Agent, make a claim for payment as provided under the provisions of applicable law.

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§ 9.8 SUBSTANTIAL COMPLETION

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Design Agent a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Design Agent will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Design Agent's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Design Agent. In such case, the Contractor shall then submit a request for another inspection by the Design Agent to determine Substantial Completion. The Design Agent will perform no more than 2 inspections to determine whether the Work or a designated portion thereof has attained Substantial Completion in accordance with the Contract Documents. The Owner is entitled to reimbursement from the Contractor for amounts paid to the Design Agent for any additional inspections.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Design Agent will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion, shall establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and shall fix the time within which the Contractor shall finish all items on the list accompanying the Certificate.

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§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment less the amount of five (5%) percent to be retained by the Owner in accordance with R.I. Gen. Laws § 37-12-10.1. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 PARTIAL OCCUPANCY OR USE

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer as required under Section 11.3.1.5 and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Design Agent as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Design Agent.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor and Design Agent shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 FINAL COMPLETION AND FINAL PAYMENT

§ 9.10.1 Upon receipt of the Contractor's written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Design Agent will promptly make such inspection and, when the Design Agent finds the Work acceptable under the Contract Documents and the Contract fully performed, the Design Agent will promptly issue a final Certificate for Payment stating that to the best of the Design Agent's knowledge, information and belief, and on the basis of the Design Agent's on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Design Agent's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled. The Design Agent will perform no more than 2 inspections to determine whether the Work or a designated portion thereof has attained Final Completion in accordance with the Contract Documents. The Owner is entitled to reimbursement from the Contractor for amounts paid to the Design Agent for any additional inspections.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Design Agent (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 working days' prior written notice has been given to the Owner, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner, and (6) all other close-out documents required by the Owner, including without limitation, all as-built plans, warranties, manuals, and other materials set forth in the Contract Documents. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

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§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Design Agent so confirms, the Owner shall, upon application by the Contractor and certification by the Design Agent, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Design Agent prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from:

- **.1** liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- **.2** failure of the Work to comply with the requirements of the Contract Documents;
- **.3** terms of special warranties required by the Contract Documents; or
- **.4** claims permitted under the State of Rhode Island General Conditions of Purchase Regulation.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

§ 9.11 The Contractor and the Contractor's surety shall be liable for and shall pay the Owner as liquidated damages the sums specified in the Solicitation and Bid Form, or if completed, the amount set forth in Section 3.4 of the Agreement.

§ 9.12 Warranties required by the Contract Documents shall commence on the date of Final Completion of the Work.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 SAFETY PRECAUTIONS AND PROGRAMS

The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 SAFETY OF PERSONS AND PROPERTY

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to:

- **.1** employees on the Work and other persons who may be affected thereby;
- **.2** the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors; and
- **.3** other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss.

§ 10.2.3 The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards, promulgating safety regulations and notifying owners and users of adjacent sites and utilities.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel and in consultation with the appropriate governmental authorities.

§ 10.2.4.1 When use or storage of explosives, or other hazardous materials, substances or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall give the User Agency and the Owner reasonable advance notice.

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§ 10.2.4.2 If the Contract Documents require the Contractor to handle materials or substances that under certain circumstances may be designated as hazardous, the Contractor shall handle such materials in an appropriate manner.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3, except damage or loss attributable to acts or omissions of the Owner or Design Agent or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Design Agent.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 INJURY OR DAMAGE TO PERSON OR PROPERTY
If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, written notice of such injury or damage, whether or not insured, shall be given to the other party within a reasonable time. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 HAZARDOUS MATERIALS
§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner and Design Agent in writing.

§ 10.3.2 Upon receipt of the Contractor's written notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Design Agent the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of such material or substance or who are to perform the task of removal or safe containment of such material or substance. The Contractor and the Design Agent will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Design Agent has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Design Agent have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased in the amount of the Contractor's reasonable additional costs of shut-down, delay and start-up.

§ 10.3.3 To the extent permitted by the provisions of R.I. Gen. Laws §§ 9-31-1 et seq., the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Design Agent, Design Agent's consultants and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss or expense is due to the fault or negligence of the party seeking indemnity.

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§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall indemnify the Owner for the cost and expense the Owner incurs (1) for remediation of a material or substance the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all cost and expense thereby incurred.

§ 10.4 EMERGENCIES

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 CONTRACTOR'S LIABILITY INSURANCE

§ 11.1.1 The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurance as is specified in the Solicitation and as will protect the Contractor from claims set forth below which may arise out of or result from the Contractor's operations and completed operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

- **.1** Claims under workers' compensation, disability benefit and other similar employee benefit acts that are applicable to the Work to be performed;
- **.2** Claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;
- **.3** Claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;
- **.4** Claims for damages insured by usual personal injury liability coverage;
- **.5** Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;
- **.6** Claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;
- **.7** Claims for bodily injury or property damage arising out of completed operations; and
- **.8** Claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.

§ 11.1.1.2 The Contractor's liability insurance shall include all major coverages and be on a comprehensive general liability basis.

§ 11.1.2 The insurance required by Section 11.1.1 shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater. Coverages, whether written on an occurrence or claims-made basis, shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and, with respect to the Contractor's completed operations coverage, until the expiration of the period for correction of Work or for such other period for maintenance of completed operations coverage as specified in the Contract Documents.

§ 11.1.3 Certificates of insurance as specified in the Solicitation and as otherwise acceptable to the Owner shall be filed with the Owner and the User Agency prior to commencement of the Work and thereafter upon renewal or replacement of each required policy of insurance. These certificates and the insurance policies required by this Section 11.1 shall contain a provision that coverages afforded under the policies will not be canceled or allowed to expire until at least 30 working days' prior written notice has been given to the Owner and the User Agency. An additional

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certificate evidencing continuation of liability coverage, including coverage for completed operations, shall be submitted with the final Application for Payment as required by Section 9.10.2 and thereafter upon renewal or replacement of such coverage until the expiration of the time required by Section 11.1.2. Information concerning reduction of coverage on account of revised limits or claims paid under the General Aggregate, or both, shall be furnished by the Contractor with reasonable promptness.

§ 11.1.4 The Contractor shall cause the commercial liability coverage required by the Contract Documents to include (1) the Owner, the User Agency, and their elected and appointed officials, members, employees, and agents, the Design Agent and the Design Agent's consultants as additional insureds for claims caused in whole or in part by the Contractor's acts or omissions during the Contractor's operations; and (2) the Owner, the User Agency, and their elected and appointed officials, members, employees, and agents, as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations.

§ 11.1.5 The Contractor shall be responsible for the prompt payment to the Owner of any deductible amounts under any insurance policies required under the Contract Documents for claims made pursuant to such policies.

§ 11.2 OWNER'S LIABILITY INSURANCE.

§ 11.2.1 The Contractor shall furnish the Owner and the User Agency, through the Design Agent, an insurance certificate providing Owner's Protective Liability extended to include the interests of the Design Agent, and to protect the Owner, User Agency, and Design Agent from any liability which might be incurred against any of them as a result of any operation of the Contractor or Subcontractors or their employees or anyone for whom either the Contractor or Subcontractors are responsible. Such insurance shall be written for the same limits as the Contractor's commercial general liability insurance and shall include the same coverage.

§ 11.2.2 If the Owner engages separate contractors to perform work for, or in or around, the Project, it shall require in its contracts with each separate contractor that Contractor and its officers, directors, partners, members, employees, and agents shall be: (i) named as additional insureds on a primary, noncontributory basis to any commercial general liability, pollution liability, and excess liability insurance policies; and (ii) provided a waiver of subrogation on all workers compensation and professional liability insurance policies.

§ 11.3 PROPERTY INSURANCE

§ 11.3.1 The Contractor shall purchase and maintain, in a company or companies lawfully authorized to do business in the state of Rhode Island, property insurance written on a builder's risk "all-risk" or equivalent policy form in the amount of the initial Contract Sum, plus value of subsequent Contract Modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 9.10 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 11.3 to be covered, whichever is later. This insurance shall include interests of the Owner, the User Agency, the Contractor, Subcontractors and Sub-subcontractors in the Project. If the Owner and/or the User Agency incur any damages by failure of the Contractor to maintain such insurance, then the Contractor shall bear all reasonable cost resulting from such failure.

§ 11.3.1.1 Property insurance shall be on an "all-risk" or equivalent policy form and shall include, without limitation, insurance against the perils of fire (with extended coverage) and physical loss or damage including, without duplication of coverage, theft, vandalism, malicious mischief, collapse, earthquake, flood, windstorm, falsework, testing and startup, temporary buildings and debris removal including demolition occasioned by enforcement of any applicable legal requirements, and shall cover reasonable compensation for Design Agent's and Contractor's services and expenses required as a result of such insured loss.

§ 11.3.1.2 Deleted.

§ 11.3.1.3 If the property insurance requires deductibles, the Owner shall pay costs not covered because of such deductibles.

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§ 11.3.1.4 This property insurance shall cover portions of the Work stored off the site, and also portions of the Work in transit.

§ 11.3.1.5 Partial occupancy or use in accordance with Section 9.9 shall not commence until the insurance company or companies providing property insurance have consented to such partial occupancy or use by endorsement or otherwise. The Contractor shall take reasonable steps to obtain consent of the insurance company or companies and shall, without mutual written consent, take no action with respect to partial occupancy or use that would cause cancellation, lapse or reduction of insurance.

§ 11.3.2 Deleted.

§ 11.3.3 Deleted.

§ 11.3.4 Deleted.

§ 11.3.5 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, the Owner shall waive all rights in accordance with the terms of Section 11.3.7 for damages caused by fire or other causes of loss covered by this separate property insurance. All separate policies shall provide this waiver of subrogation by endorsement or otherwise.

§ 11.3.6 Before an exposure to loss may occur, the Contractor shall file with the Owner a copy of each policy that includes insurance coverages required by this Section 11.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. Each policy shall contain a provision that the policy will not be canceled or allowed to expire, and that its limits will not be reduced, until at least 30 working days' prior written notice has been given to the Owner and the User Agency.

§ 11.3.7 WAIVERS OF SUBROGATION

The Contractor waives all rights against the Owner and the User Agency and any of their subcontractors, sub-subcontractors, agents and employees, and (2) the Design Agent, Design Agent's consultants, separate contractors described in Article 6, if any, and any of their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other causes of loss to the extent covered by property insurance obtained pursuant to this Section 11.3 or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the Owner as fiduciary. The Owner or Contractor, as appropriate, shall require of the Design Agent, Design Agent's consultants, separate contractors described in Article 6, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

§ 11.3.8 A loss insured under this property insurance shall be adjusted by the Contractor as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.3.10. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

§ 11.3.9 If required in writing by a party in interest, the Owner as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Contractor's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Contractor shall deposit in a separate account proceeds so received, which the Contractor shall distribute in accordance with such agreement as the parties in interest may reach, or as determined in accordance with the method of binding dispute resolution selected in the Agreement between the Owner and Contractor. If after such loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor after notification of a Change in the Work in accordance with Article 7.

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§ 11.3.10 The Contractor as fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within 5 working days after occurrence of loss to the Contractor's exercise of this power; if such objection is made, the dispute shall be resolved in the manner selected by the Owner and Contractor as the method of binding dispute resolution in the Agreement.

§ 11.4 PERFORMANCE BOND AND PAYMENT BOND

§ 11.4.1 The Contractor shall furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in the Solicitation.

§ 11.4.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 UNCOVERING OF WORK

§ 12.1.1 If a portion of the Work is covered contrary to the Design Agent's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Design Agent, be uncovered for the Design Agent's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Design Agent has not specifically requested to examine prior to its being covered, the Design Agent may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be at the Owner's expense. If such Work is not in accordance with the Contract Documents, such costs and the cost of correction shall be at the Contractor's expense unless the condition was caused by the Owner or a separate contractor in which event the Owner shall be responsible for payment of such costs.

§ 12.2 CORRECTION OF WORK

§ 12.2.1 BEFORE OR AFTER SUBSTANTIAL COMPLETION

The Contractor shall promptly correct Work rejected by the Design Agent or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Design Agent's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 AFTER SUBSTANTIAL COMPLETION

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Final Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. If the Contractor fails to correct nonconforming Work within a reasonable time after receipt of notice from the Owner or Design Agent, the Owner may correct it in accordance with Section 2.4.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.2.4 Upon request by the Owner and prior to the expiration of one year from the date of Final Completion, the Design Agent will conduct and the Contractor shall attend 2 meetings with the Owner to review the facility operations and performance.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

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§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of the Owner or separate contractors caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 ACCEPTANCE OF NONCONFORMING WORK

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 GOVERNING LAW

The Contract shall be governed by the law of the State of Rhode Island.

§ 13.2 SUCCESSORS AND ASSIGNS

§ 13.2.1 The Owner and Contractor respectively bind themselves, their successors, assigns and legal representatives to covenants, agreements and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to any executive, legislative, judicial, regulatory, or administrative body of the state, or any political subdivision thereof, including without limitation, any department, division, agency, commission, board, office, bureau, authority, school, water, or fire district, or other agency of Rhode Island state or local government that exercises governmental functions, any other governmental authority, and any quasi-public corporation and/or body corporate and politic. The Contractor shall execute all consents reasonably required to facilitate such assignment.

§ 13.3 WRITTEN NOTICE

Written notice shall be deemed to have been duly served if delivered in person to the individual, to a member of the firm or entity, or to an officer of the corporation for which it was intended; or if delivered at, or sent by registered or certified mail or by courier service providing proof of delivery to, the last business address known to the party giving notice, or when received, if manually delivered or transmitted by electronic mail or facsimile to the last such address known to the party giving notice.

§ 13.4 RIGHTS AND REMEDIES

§ 13.4.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

§ 13.4.2 No action or failure to act by the Owner, Design Agent or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach there under, except as may be specifically agreed in writing.

§ 13.5 TESTS AND INSPECTIONS

§ 13.5.1 Tests, inspections and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Design

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Agent timely notice of when and where tests and inspections are to be made so that the Design Agent may be present for such procedures. The Owner shall bear costs of (1) tests, inspections or approvals that do not become requirements until after bids are received or negotiations concluded, and (2) tests, inspections or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating their cost to the Contractor.

§ 13.5.2 If the Design Agent, Owner or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection or approval not included under Section 13.5.1, the Design Agent will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection or approval by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Design Agent of when and where tests and inspections are to be made so that the Design Agent may be present for such procedures. Such costs, except as provided in Section 13.5.3, shall be at the Owner's expense.

§ 13.5.3 If such procedures for testing, inspection or approval under Sections 13.5.1 and 13.5.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure including those of repeated procedures and compensation for the Design Agent's services and expenses shall be at the Contractor's expense.

§ 13.5.4 Required certificates of testing, inspection or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Design Agent.

§ 13.5.5 If the Design Agent is to observe tests, inspections or approvals required by the Contract Documents, the Design Agent will do so promptly and, where practicable, at the normal place of testing.

§ 13.5.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.6 INTEREST

No interest shall be due or payable on account of any payment due or unpaid under the Contract Documents except in accordance with the provisions of "Prompt Payment by Department of Administration," R.I. Gen. Laws §§ 42-11.1-1 et seq.

§ 13.7 TIME LIMITS ON CLAIMS

The Owner and Contractor shall commence all claims and causes of action, whether in contract, tort, breach of warranty or otherwise, against the other arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in the Agreement within the time period specified by applicable law. The Owner and Contractor waive all claims and causes of action not commenced in accordance with this Section 13.7.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 TERMINATION BY THE CONTRACTOR

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 calendar days through no act or fault of the Contractor or a Subcontractor, Sub-subcontractor or their agents or employees or any other persons or entities performing portions of the Work under direct or indirect contract with the Contractor, for any of the following reasons:

- **.1** Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- **.2** An act of government, such as a declaration of national emergency that requires all Work to be stopped; or
- **.3** Because the Design Agent has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1

§ 14.1.2 Deleted.

§ 14.1.3 If one of the reasons described in Section 14.1.1 exists, the Contractor may, upon 7 working days' written notice to the Owner and Design Agent, terminate the Contract and recover from the Owner payment for Work executed.

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§ 14.1.4 If the Work is stopped for a period of 60 calendar days through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing portions of the Work under contract with the Contractor because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon 7 additional days' written notice to the Owner and the Design Agent, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 TERMINATION BY THE OWNER FOR CAUSE

§ 14.2.1 The Owner may terminate the Contract if the Contractor:

- **.1** refuses or fails to supply enough properly skilled workers or proper materials;
- **.2** fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
- **.3** disregards or fails to comply with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority;
- **.4** otherwise is guilty of breach of a provision of the Contract Documents; or
- **.5** cancels or the Contractor or the Owner receives notice of cancellation or nonrenewal of any insurance required under the Contract Documents.

§ 14.2.2 When any of the above reasons exist, the Owner, upon certification by the Initial Decision Maker that sufficient cause exists to justify such action, may without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, 7 working days' written notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- **.1** Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- **.2** Accept assignment of subcontracts pursuant to Section 5.4; and
- **.3** Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Design Agent's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 SUSPENSION BY THE OWNER FOR CONVENIENCE

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Owner shall not be liable to the Contractor or any Subcontractor for claims or damages of any nature caused by or arising out of any delays. The sole remedy against the Owner for delays shall be the allowance of additional time for completion of the Work in accordance with the provisions of Section 8.3.1.

§ 14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of written notice from the Owner of such termination for the Owner's convenience, the Contractor shall:

- **.1** cease operations as directed by the Owner in the notice;
- **.2** take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and

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.3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 CLAIMS

§ 15.1.1 DEFINITION

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim.

§ 15.1.2 NOTICE OF CLAIMS

Claims by either the Owner or Contractor must be initiated by written notice to the other party. Such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly serviced if delivered in person, by mail, by courier, or by electronic transmission. Claims by either party must be initiated within 21 working days after occurrence of the event giving rise to such Claim or within 21 working days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3 CONTINUING CONTRACT PERFORMANCE

Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents. The Design Agent will prepare Change Orders and issue Certificates for Payment in accordance with the decisions of the Initial Decision Maker.

§ 15.1.4 CLAIMS FOR ADDITIONAL COST

If the Contractor wishes to make a Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.5 CLAIMS FOR ADDITIONAL TIME

§ 15.1.5.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, written notice as provided herein shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.5.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated and had an adverse effect on the scheduled construction.

§ 15.1.5.3 Claims for increase in the Contract Time shall set forth in detail the circumstances that form the basis for the Claim, the date upon which each cause of delay began to affect the progress of the Work, the date upon which each cause of delay ceased to affect the progress of the Work and the number of days' increase in the Contract Time claimed as a consequence of each such cause of delay. The Contractor shall provide such supporting documentation as the Owner may require including, where appropriate, a revised construction schedule indicating all the activities affected by the circumstances forming the basis of the Claim.

§ 15.1.5.4 The Contractor shall not be entitled to a separate increase in the Contract Time for each one of the number of causes of delay which may have concurrent or interrelated effects on the progress of the Work, or for concurrent delays due to the fault of the Contractor.

§ 15.1.6 The Contractor waives Claims against the Owner for consequential damages arising out of or relating to this Contract. This waiver includes damages incurred by the Contractor for principal office expenses, including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit. This waiver is applicable, without limitation, to all consequential damages

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due to the Contractor's termination in accordance with Article 14. Nothing in this Section 15.1.6 shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 INITIAL DECISION

§ 15.2.1 Claims shall be referred to the Initial Decision Maker for initial decision. The Purchasing Agent appointed pursuant to the provisions of the "State Purchases Act," R.I. Gen. Laws § 37-2-1 et seq., will serve as the Initial Decision Maker in accordance with the provisions of the State Purchases Act, State of Rhode Island Procurement Regulations, and this Section 15.2.1. An initial decision shall be required as a condition precedent to binding dispute resolution pursuant to Section 15.3.1 of any Claim arising prior to the date final payment is due.

§ 15.2.2 Deleted.

§ 15.2.3 Deleted.

§ 15.2.4 Deleted.

§ 15.2.5 Deleted.

§ 15.2.6 Deleted.

§ 15.2.6.1 Deleted.

§ 15.2.7 Deleted.

§ 15.2.8 Deleted.

§ 15.3 MEDIATION

§ 15.3.1 For any Claim not resolved by the Initial Decision Maker procedures set forth in Section 15.2.1, and prior to the implementation of the binding dispute resolution procedures set forth in Section 15.4.1, the Contractor or the Design Agent shall have the option to pursue mediation, exercisable by written notice to the Owner within 30 calendar days of an Initial Decision. In the event of the exercise of such option by the Contractor or the Design Agent, the Owner and the Contractor or the Design Agent shall attempt to select a mediator, and in the event that the Owner and the Contractor or the Design Agent cannot agree on a mediator, either party may apply in writing to the Presiding Justice of the Providence County Superior Court, with a copy to the other, with a request for the court to appoint a mediator, and the costs of the mediator shall be borne equally by both parties.

§ 15.3.2 Deleted.

§ 15.3.3 Deleted.

§ 15.4 BINDING DISPUTE RESOLUTION

§ 15.4.1 For any Claim not resolved by the Initial Decision Maker procedures set forth in Section 15.2.1, or mediation at the option of the Contractor pursuant to Section 15.3.1, the method of binding dispute resolution shall be determined in accordance with the provisions of the "Public Works Arbitration Act," R.I. Gen. Laws §§ 37-16-1 et seq.

§ 15.4.4 Deleted.

§ 15.4.4.1 Deleted.

§ 15.4.4.2 Deleted.

§ 15.4.4.3 Deleted.

§ 16 COMPLIANCE WITH APPLICABLE LAW

The Contractor and its Subcontractors shall comply with all applicable federal, state, and local laws.

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User Notes: (1870164535)

00 73 01 – HOT WORK PROCEDURE

PART 1 - GENERAL

The following procedure applies to the Contract for Construction and is a part of the Contract Documents:

WELDING, CUTTING AND BRAZING HOT WORK PROCEDURE

1.1 PURPOSE

To establish regulations and rules for the safe uses of open flames and spark producing equipment in state owned or leased facilities. Applicable regulations pertinent to this guide include OSHA 29 CFR 1910.252-.255 and NFPA 51B, and the insurers Hot Work Requirements in addition to F.M. Global requirements.

1.2 POLICY

A. Fire Protection

1. Contractors and employees shall comply with the regulations set forth in this policy to ensure the safe use of open flames and spark producing equipment.
2. When performing work within a state facility with a cutting torch or when using welding, brazing or soldering equipment a hot work permit is required to be filled out and precautions followed. The Hot Work Permits are available (free of charge) directly from the state's property insurer.
3. Prior to the start of the hot work operation, the contractor is to coordinate deactivation of related of the alarm system necessary to prevent false alarms prior to the start of the hot work operation with the Owner's warrantee vendor, all cost to be included in Base Bid.
4. Upon completion of the project the fire alarm system will be restored to operational status.
5. During the hot work operation the following precautions will be followed:
   a. A fire watch will be required by the individual responsible for authorizing the hot work operation.
   b. Welding leads and burning hoses are to be kept out of walkways as much as possible
   c. Inspect all leads, grounds, clamps, torches and cylinders before use. Be sure all fittings, couplings and connections are tight.
   d. In gas welding and cutting, mixtures of fuel gas and air or oxygen must not be permitted except prior to consumption.
   e. Only approved apparatus must be used, and portable cylinders of compressed gas must be properly secured to prevent upset.
   f. Use proper ventilation in the work area.
   g. All exposed combustible and flammable material within 35 feet of the point of operation should be removed where possible. Otherwise, protect with Approved welding pads, blankets and curtains, fire resistive tarpaulins or metal shields.
   h. Cutting or welding on pipes or other metal in contact with combustible walls, partitions, ceilings or roofs shall not be undertaken if the work is close enough to cause ignition by conduction.
   i. All hoses and leads will be inspected frequently and will be replaced as necessary.
   j. A cutting or welding prohibition will be required whenever an area contains or may contain flammable/explosive vapors. The prohibition can only be lifted when the area

has been purged and cleaned and the area has been tested and shown to be free of a flammable/explosive mix.

1.3 RESPONSIBILITY

A. Supervisor

1. Supervisor will train their employees in the potential fire hazards associated with hot work.
2. Supervisor will initiate a hot work permit prior to assigning work.
3. The supervisor will obtain confirmation that:
   a. Available sprinklers, hose streams and extinguishers are in service and operable. 2.) Hot work equipment is in good working condition.
   b. The following requirements within 35 feet of hot work shall be adhered to: a.) Flammable liquid, dust, lint and oily deposits have been removed. b.) Explosive atmosphere has been eliminated.
   c. The floors have been swept clean.
   d. Combustible floors have been wet down, covered with damp sand or fire resistive sheets are in place.
   e. All exposed combustible and flammable material within 35 feet of the point of operation should be removed where possible. Otherwise, protect with FM Approved welding pads, blankets and curtains, fire resistive tarpaulins or metal shields.
   f. All wall and floor openings are covered.
   g. FM approved welding pads, blankets and curtains installed under and around work.
   h. Protect or shut down ducts and conveyors that might carry sparks to distant combustible material.
4. The supervisor is responsible for assuring that a 60 minute fire watch is maintained at the completion of all hot work assignments, that a hot work permit has been acquired for work involving open flames or spark producing tools and for assuring all fire prevention procedures and precautions are followed for protection of people and property including a fire watch, deactivation of the fire alarm.
5. The supervisor will require that the area be monitored periodically for three hours after the fire watch is completed.
6. The supervisor will confirm that employees are trained in use of fire extinguishers and hoses, and that the employees are familiar with emergency procedures in the event of a fire.
7. At least once while the permit is in effect, the area should be inspected by the individual responsible for authorizing, cutting or welding operations to ensure that it is a fire safe area. (See article 3 above for fire safe conditions.)
8. Proper personnel protective equipment including helmets, eye wear, face and hand shields applicable to the equipment used will be provided by the supervisor.
   a. The equipment will be maintained and fit tested by management.
9. Personal protective clothing consistent with OSHA standards will be worn.
10. Tarps or fire resistant coverings sufficient to cover combustible materials within 35 feet of the operation will be provided.

B. Employees

1. The employee shall be responsible to work in a safe manner and follow all safety precautions as trained by the supervisor.

2. The employee charged with performing the hot work will initiate part 2 of the hot work permit and verify that a 60 minute fire watch has been maintained.
3. Employees performing hot work will be required to either properly remove or cover combustible materials in the 35 foot area surrounding the hot work operation.

C. Management
1. Maintain a log of hot work permits.
2. Provide safety training for supervisors.
3. Confirm that all contractors follow all requirements of this protocol.

D. Hot Work Permits.
1. At least 3 business days in advance of hot work, contractor shall obtain a hot work permit from CCRI Physical Plant. Scan a copy to the CCRI Capital Projects Office and return the hard copy of the permit to Physical Plant.
2. A sample hot work permit is enclosed for reference only. Only Hot Work Permits in their original format will be accepted.
3. Owner reserves the right to call for a pre-construction meeting prior to the hot work taking place.

HOT WORK PERMIT

STOP!

Avoid hot work or seek an alternative/safer method, if possible.

This *Hot Work Permit* is required for any temporary operation involving open flames or producing heat and/or spa
This includes, but is not limited to: brazing, cutting, grinding, soldering, torch-applied roofing and welding.

Part 1

Instructions

1. **Firesafety supervisor:**
   - **A.** Verify precautions listed at right (or do not proceed with the work).
   - **B.** Complete and retain Part 1. (**Part 1A** is for quality assurance documentation, if necessary.)
   - **C.** Issue **Part 2** to person performing hot work.

HOT WORK BY
☐ Employee
☐ Contractor _____

DATE	JOB NUMBER

LOCATION/BUILDING AND FLOOR

NATURE OF JOB

NAME (PRINT) AND SIGNATURE OF PERSON PERFORMING HOT WORK

I verify the above location has been examined, the precautions checked on the Required Precautions Checklist have been taken to prevent fire, and permission is authorized for this work.

NAME (PRINT) AND SIGNATURE OF FIRESAFETY SUPERVISOR/OPERATIONS SUPERVISOR

TIME STARTED: a.m. p.m. TIME FINISHED: a.m. p.m.

Permit Expires	DATE	TIME a.m. p.m.

Note: Emergency notification on back of form.
Use as appropriate for your facility.

To order additional hot work permits or other FM Global resources, order online 24 hours a day, seven days a week, at www.fmglobalcatalog.com.

FM Global

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Required Precautions Checklist

- ☐ Control valves to water supply for sprinkler system are open.
- ☐ Hose streams and extinguishers are in service/operable.
- ☐ Hot work equipment in good working condition.

Requirements within 35 ft. (11 m) of hot work

- ☐ Flammable liquid, dust, lint and oily deposits removed.
- ☐ Explosive atmosphere in area eliminated.
- ☐ Floors swept clean.
- ☐ Combustible floors wet down, covered with damp sand or fire-resistive sheets.
- ☐ Remove other combustible material where possible. Otherwise, protect with FM Approved welding pads, blanket and curtains, fire-resistive tarpaulins or metal shields.
- ☐ All wall and floor openings covered.
- ☐ FM Approved welding pads, blankets and curtains installed u and around work.
- ☐ Protect or shut down ducts and conveyors that might carry s to distant combustible material.

Hot work on walls, ceilings or roofs

- ☐ Construction is noncombustible and without combustible cov or insulation.
- ☐ Combustible material on other side of walls, ceilings or roofs is

Hot work on enclosed equipment

- ☐ Enclosed equipment cleaned of all combustible material.
- ☐ Containers purged of flammable liquid/vapor.
- ☐ Pressurized vessels, piping and equipment removed from ser isolated and vented.

Fire watch/hot work area monitoring

- ☐ Fire watch will be provided during and for one (1) hour after w including any break activity.
- ☐ Fire watch is supplied with suitable extinguishers, and where a charged small hose.
- ☐ Fire watch is trained in use of equipment and in sounding ala
- ☐ Fire watch may be required in adjoining areas, above and bel
- ☐ Monitor hot work area for up to an additional three (3) hours one (1) hour fire watch.

☐ **Other precautions taken:**

_____
_____
_____
_____

END OF SECTION

00 73 02 – MANAGING FIRE PROTECTION SYSTEM IMPAIRMENT
PART 1 - GENERAL

1.1 IMPLEMENTATION

A. The following management procedure applies to the Contract for Construction and is a part of the Contract Documents.

1.2 MANAGING FIRE PROTECTION SYSTEM IMPAIRMENT

A. Impairment to fire protection equipment is a situation in which the system is shut off, either in whole or in part. The impairment may be necessary to conduct scheduled maintenance of equipment or to make emergency repairs. Impairment may also be due to new construction. Normal system tests and inspections are not considered impairment.

B. Regardless of the reason, impairment results in the sprinkler system and/or fire alarm system being temporarily out of service, such a condition may result in severe property loss in the event of a fire. Locations protected by automatic sprinkler systems must have an impairment handling program to control situations when sprinkler systems must be shut down.

C. Whenever a sprinkler system has been impaired all hot work in the area of the impaired system should be prohibited.

D. A periodic fire watch should be established when either the sprinkler system or the fire alarm system is out of service.

E. The State's property insurance carrier recommends an impairment handling kit. The Red Tag Permit System consists of four key elements:
   1. A Red Tag Permit
   2. Fire Protection Equipment Decals
   3. Reusable Impairment Tag for Fire Service Connections
   4. Red Tag Permit System Wall Hanger

F. The Fire Protection Equipment Decals are to be affixed to fire protection equipment as a reminder that authorization is needed before any shut down can occur.

G. The Red Tag Permit System Wall Hanger contains pockets to keep other elements of the system organized and within reach; also the Hanger lists steps to be taken before, during and after impairment. The Wall Hanger also lists the contact to be notified of the impairment.

H. There is space on the notification tag for the phone numbers of the Fire department, Alarm Company, and the local Water Department as well.

I. An engineer and/or client service representative can advise you on how to proceed and follow up until protection has been restored. In addition this representative may be able to help minimize downtime, if possible, reduce fire exposure to the area, arrange for temporary protection and determine how to restore protection as quickly as possible.

J. For scheduled maintenance of fire alarm systems, vendors must as prescribed in Rhode Island Fire Codes notify the building owner 48 hours in advance of pending maintenance.

K. All fire protection system work must be planned with the project manager at least 7 days in advance.

L. Contractor is responsible for having fire alarm subcontractor present while sprinkler work is on-going to manage fire alarm modifications during the work. Owner will not provide this service.

M. As part of the base contract, the Contractor is required to provide a licensed electrician to oversee and perform the required temporary modifications to the fire alarm system during impairment,

including bypass control during fire sprinkler work. The College will not provide personnel for this purpose.

END OF SECTION

00 73 30 - PERFORMANCE BOND

1. Refer to the State Agency Solicitation provided by the State for Performance Bond requirements.

END OF DOCUMENT

00 73 31 - PAYMENT BOND

1. Refer to the State Agency Solicitation provided by the State for Payment Bond requirements.

END OF DOCUMENT

00 73 36 – PREVAILING WAGE RATES

The State of Rhode Island Department of Labor, Division of Professional Regulation General Decision Modification document is an integral part of the Bid Documents for use in fulfilling prevailing wage rate requirements. A copy is available linked to the web site of the State of Rhode Island Department of Administration, Division of Purchases. Contractors working on RI Prevailing Wage projects must adjust employee hourly rates every July 1 in accordance with updated Davis Bacon rates. These rates may be obtained at the following website:

www.wdol.gov/dba.aspx

The Division of Purchases Web Site Address is: http://www.purchasing.ri.gov/RIVIP/Info.asp

The link for the US Government prevailing wage tables is:
http://www.purchasing.ri.gov/bidinfo/geninfo/geninfo.aspx

Applicable Rhode Island labor laws may be found at: http://www.dlt.ri.gov/pw/

END OF SECTION

00 90 00 – ADDENDA AND MODIFICATIONS

PART 1 - GENERAL

A. As of the time of publication of this Project Manual, no Addenda had been issued.

B. Should Addenda be issued during the Bid Period, they will augment this Document and become a part of the Project Manual.

C. Such Addenda and Modifications when issued, with reference to the Project Manual, the General Conditions, Supplemental General Conditions, Drawings or Specifications, shall be inserted following this page and become integral parts of the Contract Documents.

END OF SECTION

SECTION 01 01 50 EXISTING CONDITIONS

PART 1- GENERAL

1.01 1.01 SUMMARY

A. EXISTING CONDITIONS SURVEY

1. Before submitting a bid, the Contractor shall make a thorough examination of the conditions of the site, checking the requirements of the Plans and Specifications with the existing conditions.
2. No claim for extra compensation or extension of time will be allowed on account of the Contractor's failure to estimate properly the quantities, locations and measurements of all items required to complete the work.
3. The Contractor shall report any discrepancies to the Architect and request and interpretation before submitting a bid.

END OF SECTION

SECTION 01 10 00 - SUMMARY OF WORK

PART 1 -GENERAL

1.01 DESCRIPTION OF WORK

A. Overview: Contractor to provide all labor, materials and equipment required to renovate the indicated rooms on the 2nd floor of the Knight Campus building of CCRI in accordance with the Construction Documents, including the specifications and/or drawings listed in this Project Manual. Work will be completed in 2 phases. Phase I 7/1/2020 – 4/30/2021, Phase II 5/30/2021 – 1/16/2022. Work shall include, but is not limited to, the following:

1. Demolition of existing casework, finishes, lighting, equipment, & overhead coiling classroom grilles as detailed on the drawings.
2. New construction of partitions at former overhead grilles to divide classrooms from corridor.
3. New construction of Faraday Cage / EMF shielded classroom space.
4. New casework & furniture installations.
5. Selective demolition of existing mechanical, plumbing, electrical, & tel./data systems as documented on the MEP/FP drawings.
6. Modifications and new additions to existing mechanical, plumbing, electrical, & tel./data systems as documented on the MEP/FP drawings.
7. Complete all work within the calendar days noted on the CCRI Bid Form regardless of weather, product delivery constraints, or season start date.
8. Contractor to include temporary signage as required by the College during construction abatement activities.

B. General Requirements:

1. Contractor shall perform the Work of the Contract under a stipulated sum Contract with the Owner in accordance with the Conditions of Contract.
2. Vendor is responsible for obtaining and paying for any required Local and State licenses, Permits and inspections, other than State Fire Plan Review fees, which are pre-paid.
3. Contractor to include all Bond costs in their Bid.
5. Before starting work, all Contractor workers and Subs are required to obtain and submit a current (within 6 months) State BCI and State-approved picture ID. BCI must be obtained from the state of residence of the state of Rhode Island. CCRI College Police reserves the right to deny Campus access to any worker based on information provided on the submitted BCI.
6. All workers are to be OSHA 10 certified. Copies of this certification along with driver licenses are required on the first day of work.
7. The Contractor is responsible for providing their workers with all personal protection equipment. At a minimum, this includes hard hats, reflective vests, eye protection, harnesses and ear protection.
8. All completed work must be inspected and approved by the College and the Design Agent.
9. There will be mandatory bi-weekly progress meetings with four week look-ahead schedules to be furnished to the Design Agent and College.

10. Contractor and/or its subcontractors are to be licensed as required by Rl Department of Labor. Install Brown paper on E1 line on the interior windows facing the commons during construction. Vendor is responsible for all temporary heating and cooling during construction to maintain temperatures during school operations.
11. All contractors and subcontractors to sign in each employee at the CCRI Security Office located on the lower level at the start of each shift.
12. Deliveries to be coordinated with the college and to occur at or before 6:00 AM.
13. The Successful Bidder is to submit the names and resumes of the onsite supervisors for review and acceptance to work on campus by the College team. The College reserves the right to reject any proposed onsite supervisors.
14. The College is not responsible for security of materials, tools, etc.
15. Contractors are not permitted to display a project sign anywhere on the campus grounds.
16. Contractor must come to terms with all vendors and subcontractors prior to submitting their bid.
17. Contractor will provide barricades and signage as required to segregate the construction area from normal use as required.
19. All work is to be done during 3rd shift. 10:30 P.M. to 6:00 A.M.
20. There is no storage within the building.
21. Included conex boxes to store owner furnishings for reuse in the labs.
22. Make repairs to existing block wall in Room 2026 (Phase II) per Geisser report.

1.02 ALTERNATES - NOT USED.

1.03 CONTRACTOR'S USE OF SITE AND PREMISES

A. Owner intends to fully occupy the facility during the period of construction.

B. Construction Operations: Limit work areas within the building as agreed with the College. Coordinate with Owner to insure delivery and completion per the schedule identified on the Bid Form. Include all costs of this coordination, including all premium time wages that may be required to meet these requirements, in the Base bid.

C. Provide access to and from site as required by law and by Owner:

1. Building Emergency Exits during Construction: Keep required exits open during construction period as appropriate to the construction work being performed at the time. Provide temporary exit signs if exit routes are temporarily altered.
2. Do not obstruct corridors without permission from the Owner. (Corridors are to remain open at all times)

D. Utility Outages and Shutdown:

1. Do not disrupt or shut down life safety systems, including but not limited to fire sprinkler system and fire alarm system, without 7 days' notice to Owner and authorities having jurisdiction.
2. Prevent accidental disruption of utility services to other areas of the facility. Any and all shutdowns to occur during third shift.

3. Do not disrupt building control wiring or fire alarm wiring passing through the area of work.

E. Protect all existing surfaces from damages. Any damages to the existing surfaces requiring replacement and or repair will be at this vendor's expense.

F. At all times and at the completion of the Project, construction areas are to be kept in a clean, safe and acceptable condition on a daily basis.

G. Vendor is responsible for removing all project debris off site daily including all costs associated with waste containers and proper disposal of waste. The College will provide an exterior location for the temporary placement of a waste container.

H. Vendor is to have all equipment necessary to perform the installation and service including, tools, staging, lift truck, etc. No CCRI equipment or tools will be available.

I. Any work that affects the fire suppression and fire alarm systems is to be coordinated with the College contracted maintenance companies to insure warranty continuity with all costs included in the base bid. Encore is the vendor for Sprinkler work, and FSI is the vendor for fire alarm work.

J. Under no circumstances is the general contractor to disrupt the operation of the owner.

1.04 ITEMS PROVIDED BY OWNER INSTALLED BY CONTRACTOR

A. Coordinate with Owner for any such items.

1.05 WORK BY OWNER

A. Items noted NIC (Not in Contract) will be supplied and installed by Owner before Substantial Completion. Some items include:

1. No such items are identified at this time.

1.06 OWNER REQUIRED SUBCONTRACTORS

A. Warranty holders on fire alarm and sprinkler systems.

1.07 ITEMS TO BE SALVAGED

A. Coordinate with Owner any such items.

1.08 HAZARDOUS MATERIALS

A. Refer to Section 003102 for directives on the presence of hazardous materials.

1.09 ALLOWANCES

A. Allowance #1: Include a $50,000 allowance for unforeseen or concealed conditions.

B. Allowance #2: Include a $70,000 allowance for additional work as directed by the College.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

PART 1 -GENERAL

1.01 DESCRIPTION OF WORK

A. Overview: Contractor to provide all labor, materials and equipment required to renovate the indicated rooms on the 2nd floor of the Knight Campus building of CCRI in accordance with the Construction Documents, including the specifications and/or drawings listed in this Project Manual. Work shall include, but is not limited to, the following:

1. Demolition of existing casework, finishes, lighting, equipment, & overhead coiling classroom grilles as detailed on the drawings.

1.01 SECTION INCLUDES

A. Schedule of values.

B. Applications for payment.

C. Warranty Inspection Retainage.

D. Sales Tax Exemption.

E. Change procedures and mark-up.

F. Defect assessment.

G. Alternates.

H. Unit Prices

I. Allowances

1.02 SCHEDULE OF VALUES

A. Submit a printed schedule on AIA Form G703- Application and Certificate for Payment Continuation Sheet.

B. Submit Schedule of Values in duplicate, one copyrighted original and one copy, within 15 days after date of receipt of a Purchase Order from the State Division of Purchases.

C. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the major specification Section. Identify site mobilization, bonds and insurance.

D. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.

E. Revise schedule to list approved Change Orders, with each Application for Payment.

1.03 APPLICATIONS FOR PAYMENT

A. Submit each application on an original copyrighted AlA Form G702 -Application and Certificate for Payment and AlA G703- Continuation Sheet, accompanied by three copies.

1. Individually sign and notarize, and emboss with notary's official seal, the original and each of the three copies.

2. Applications not including original copyrighted AlA G702, and G703 Forms, will be rejected, and returned for resubmittal.

3. Applications not properly signed and notarized will be rejected and returned for re-submittal.

B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.

C. Provide one copy of the updated construction schedule with each Application for Payment submission.

1. Provide a statement signed by the Contractor's firm principal certifying that there are no unidentified outstanding claims for delay.

D. Include with each monthly Application for Payment, following the first application, one copy of the Certified Monthly Payroll Record for the previous month's pay period.

E. Payment Period: Submit at intervals stipulated in the Agreement (A.I.A . Form A101-2017).

F. Submit with transmittal letter as specified for Submittals in Section 013300.

G. Beginning with the second Application for Payment, Contractor's right to payment must be substantiated by documenting, on a copy of the Waiver of Lien Form referenced in Document 005000- Contracting Forms in this Project Manual, that payment monies due, less retainage of five percent (5%), have been paid in full to subcontractor and suppliers for work, materials, or rental of equipment billed for under specific line item numbers in the immediately preceding application.

H. Substantiating Data: When the Design Agent requires substantiating information, submit data justifying dollar amounts in question. Include the following with the Application for Payment:

1. Record Documents as specified in Section 01780, for review by the Owner which will be returned to the Contractor.
2. Affidavits attesting to off-site stored products.
3. Construction progress schedules, revised and current as specified in Section 01 3000.

I. As a condition of payment, a monthly MBE report with cancelled checks shall be attached to each invoice. This is a College requirement and is in addition to the State MBE Office Requirements.

1.04 SALES TAX EXEMPTION

A. Owner is exempt from sales tax on products permanently incorporated in Work of the Project.

1. Obtain sales tax exemption certificate number from Owner.
2. Place exemption certificate number on invoice for materials incorporated in the Work of the Project.
3. Furnish copies of invoices to Owner.
4. Upon completion of Work, file a notarized statement with Owner that all purchases made under exemption certificate were entitled to be exempt.
5. Pay legally assessed penalties for improper use of exemption certificate number.

1.05 CHANGE PROCEDURES AND MARK-UP

A. For change procedures refer to A.I.A. Form A-201-2017; Article 7 - "Changes in the Work" for requirements.

1.06 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. The authority of the Design Agent to assess the defect and identify a payment adjustment is final.

E. Defective or Rejected products are not to be installed.

1.07 ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected in numerical order at the Owner's option. Accepted Alternates will be identified in the Purchase Order. Coordinate related work and modify surrounding work as required.

B. Refer to Section 011000 Summary of Work for a description of Alternates.

1.08 UNIT PRICES

A. Unit prices as included on the Bid Form will be used to adjust the quantities of work to be compensated in the Contract based on actual field conditions. Impacted scope must be viewed by the Owner or Design Agent and documented photographically to allow accurate quantity estimates.

1.09 ALLOWANCES

A. See bid form and Section 011000 Summary of Work for allowances. All unused funds within the allowances at the conclusion of the project shall be returned to the Owner via credit change order.

END OF SECTION

MBE COMPLIANCE FORM

MBE Compliance Office
www.mbe.ri.gov (website)
1 Capitol Hill, 2nd Floor
Providence, RI 02908
401-574-8670, 401-574-8387 (fax)

Pursuant to RIGL 37-14.1 as well as the regulations promulgated thereto, the MBE Compliance Office requires that you complete the following table. Please note that these figures will be verified with the MBEs identified. If there are outstanding issues, such as retainage or a dispute, please indicate and attach supporting documentation for same. Also note that copies of invoice and cancelled checks for payment to all MBE subcontractors and suppliers are required.

Contractor/Vendor Name: _____

Project Name & Location: _____

Original Prime Contract Amount _____

Current Prime Contract Amount: _____

MBE/WBE Subcontractor	Original Contract Amount	Change Orders	Revised Contract Value	% To Date Completed	Amount Paid To Date	Amount Due	Retainage %	Retainage Amount	Explanation

I declare, under penalty of perjury, that the information provided in this verification form and supporting documents is true and correct.

_____ _____
Signature Date

_____
Printed Name

Notary Certificate:

Sworn before me this _____ day of _____ , 20__.

_____ _____
Notary Signature Commission Expires

SECTION 01 30 00 - ADMINISTRATIVE PROCEDURES

PART 1 -GENERAL

1.01 SECTION INCLUDES

A. Site Administration.

B. Coordination and project conditions.

C. Preconstruction meeting.

D. Site mobilization meeting.

E. Progress meetings.

F. Pre-installation meetings.

1.02 SITE ADMINISTRATION

A. Maintain a daily attendance log to include the names of all project employees and guests to the site. The log sheet, or sheets, must clearly indicate the Project Name, and the name of the General Contractor. Each line in the log should allow for the name of that employee, the employee's job title (use terminology used by prevailing wage job title), and the name of that employee's employer. Each quest signing the log should indicate a brief description of the reason for the visit, the quest's employer or organization.

1.03 COORDINATION AND PROJECT CONDITIONS

A. Coordinate the scheduling, submittals, and the Work of the various Sections of the Project Manual to ensure an efficient and orderly sequence of the installation of interdependent construction elements.

B. Verify that the utility requirements and characteristics of the operating equipment are compatible with the building utilities. Coordinate the Work of the various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

C. Coordinate the space requirements, weight, supports, and installation of the structural and electrical Work, which are indicated diagrammatically on the Drawings. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

D. Coordinate the completion and clean up of the Work of the separate Sections in preparation for

Substantial Completion.

1.04 PRECONSTRUCTION MEETING

A. The Design Agent will schedule a meeting after a Purchase Order is issued to the Contractor by the CCRI Department of Purchasing.

B. Attendance Required: Owner, Design Agent, and Contractor, including on-site Supervisor.

C. Agenda:

1. Distribution of the Contract Documents.
2. Submission of a list of Subcontractors, a list of products, schedule of values, and a progress schedule.

3. Designation of the personnel representing the parties in the Contract, and the Design Agent.
4. The procedures and processing of the field decisions, submittals, substitutions, applications for payments, proposal requests, Change Orders, and Contract closeout procedures.
5. Scheduling.
6. The Design Agent will record the minutes and distribute copies within two days after the meeting to all participants.

1.05 SITE MOBILIZATION MEETING

A. The Design Agent will schedule a meeting at the Project site prior to the Contractor's occupancy.
   1. Attendance Required: The Owner, Design Agent, Special Consultants, and, Contractor, the Contractor's Superintendent, and major Subcontractors.
   2. Agenda:
      a. Use of the premises by the Owner and the Contractor.
      b. The Owner's requirements and occupancy.
      c. Security and housekeeping procedures.
      d. Schedules.
      e. Application for payment procedures.
   3. The Design Agent will record the minutes and distribute the copies within two days after the meeting to all participants.

1.06 PROGRESS MEETINGS

A. Schedule and administer the meetings throughout the progress of the Work at bi- intervals.
B. The Design Agent will make arrangements for the meetings, prepare the agenda with copies for the participants, and preside at the meetings.
C. Attendance Required: The job superintendent, major subcontractors and suppliers, the Owner, Design Agent, as appropriate to agenda topics for each meeting.
D. Agenda by Contractor:
   1. Review the minutes of previous meetings.
   2. Review of the Work progress.
   3. Field observations, problems, and decisions.
   4. Identification of the problems which impede the planned progress.
   5. Review of the submittals schedule and status of the submittals- Note that all submittals are required within 14 calendar days of receipt of P.O.
   6. Review of the off-site fabrication and delivery schedules.
   7. Maintenance of the progress schedule.
   8. Corrective measures to regain the projected schedules.
   9. Planned progress during the succeeding work period.
   10. Coordination of the projected progress.

11. Maintenance of the quality and work standards.
12. Effect of the proposed changes on the progress schedule and coordination.
13. Other business relating to the Work.
14. The Design Agent will record the minutes and distribute the copies within two days after the meeting to all participants.

1.07 PRE--INSTALLATION MEETINGS

A. When required in the individual specification Sections, the Contractor shall convene a pre-installation meeting at the site prior to commencing the Work of the Section.

B. Require attendance of the parties directly affecting, or affected by, the Work of the specific Section.

C. Notify the Design Agent four days in advance of the meeting date.

D. Prepare an agenda and preside at the meeting:

1. Review the conditions of installation, preparation and installation procedures.
2. Review coordination with the related work.
3. The Design Agent will record the minutes and distribute the copies within two days after the meeting to all participants.

END OF SECTION

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 -GENERAL

1.01 SECTION INCLUDES

A. Submittal procedures.
B. Construction progress schedules.
C. Proposed products list.
D. Product data.
E. Shop drawings.
F. Samples.
G. Design data.
H. Test reports.
I. Certificates.
J. Manufacturer's instructions.
K. Manufacturer's field reports.

1.02 SUBMITTAL PROCEDURES

A. Master List Submittal:

1. Submit a master list of the required submittals with a proposed date for each item to be submitted.
2. Show the date submittal was sent, days since submittal was sent, status of submittal, date submittal was received in return, and any date associated with re-submittals.
3. Update Master List with each submission and response.
4. Transmit each submittal with a dated Design Agent accepted transmittal form.
   a. Sequentially number the transmittal form. Mark the revised submittals with an original number and a sequential alphabetic suffix.
   b. Identify the Project, Contractor, subcontractor and supplier; the pertinent drawing and detail number, and the specification Section number, appropriate to the submittal.
   c. Apply a Contractor's stamp, signed or initialed, certifying that the review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of the information is in accordance with the requirements of the Work and the Contract Documents.
   d. Schedule submittals to expedite the Project and deliver to the Design Agent at their business address. Coordinate the submission of related items.
   e. For each submittal for review, allow 15 days excluding the delivery time to and from the Contractor.
   f. Identify the variations from the Contract Documents and the Product or system limitations which may be detrimental to a successful performance of the completed Work.
   g. Allow space on the submittals for the Contractor's and the Design Agent's review

stamps.

h. When revised for resubmission, identify the changes made since the previous submission.

i. Distribute copies of the reviewed submittals as appropriate. Instruct the parties to promptly report an inability to comply with the Contract requirements.

j. Submittals not requested will not be recognized or processed.

k. Submittals Prepared Using Copyrighted AlA Forms:

1) Use only original copyrighted forms for the first typed copy of each submission. Do not use unauthorized duplications of copyrighted forms for the first typed copy.

2) Proceed to reproduce one or more copies of the first typed copy as may be required.

3) Copyrighted forms are those printed forms purchasable through an authorized outlet, or reproduced electronically under license from the AlA Electronic Document Service.

5. Submittals once approved cannot be resubmitted with alternate products unless the product is discontinued.

1.03 CONSTRUCTION PROGRESS SCHEDULES

A. Submit preliminary outline Schedules within 5 days after the date of receipt of a Purchase Order from CCRI Department of Purchasing for coordination with the Owner's requirements. After a review, submit detailed schedules within 5 days modified to accommodate the revisions recommended by the Design Agent.

B. Show a complete sequence of construction by activity, identifying the Work of separate stages and other logically grouped activities. Indicate the early and late start, the early and late finish, float dates, and the duration.

1.04 PRODUCT DATA

A. Product Data: Submit to the Design Agent for review for the limited purpose of checking for conformance with the information given and the design concept expressed in the Contract Documents. Provide copies and distribute in accordance with the SUBMITTAL PROCEDURES article and for the record documents purposes described in Section 01 7800.

B. Submit the number of copies which the Contractor requires, plus two copies the Design Agent will retain.

C. Mark each copy to identify the applicable products, models, options, and other data.

Supplement the manufacturers' standard data to provide the information specific to this Project.

D. Indicate the product utility and electrical characteristics, the utility connection requirements, and the location of utility outlets for service for functional equipment and appliances.

E. After a review distribute in accordance with the Submittal Procedures article above and provide copies for record documents described in Section 01 7800.

1.05 SHOP DRAWINGS

A. Shop Drawings: Submit to the Design Agent for review for the limited purpose of checking for conformance with the information given and the design concept expressed in the Contract Documents. Produce copies and distribute in accordance with the SUBMITTAL PROCEDURES article and for the record documents purposes described in Section 01 7800.

B. Indicate the special utility and electrical characteristics, the utility connection requirements, and the location of utility outlets for service for functional equipment and appliances.

C. Submit in electronic form for review and then 4 copies for record.

1.06 SAMPLES

A. Samples: Submit to the Design Agent for review for the limited purpose of checking for conformance with the information given and the design concept expressed in the Contract Documents. Produce duplicates and distribute in accordance with the SUBMITTAL PROCEDURES article and for the record documents purposes described in Section 01 7800.

1. Submit samples to illustrate the functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate the sample submittals for interfacing Work.
2. Include an identification on each sample, with the full Project information.
3. Submit the number of samples specified in the individual specification Sections; the Design Agent will retain one sample.
4. Reviewed samples, which may be used in the Work, are indicated in the individual specification Sections.
5. Samples will not be used for testing purposes unless they are specifically stated to be in the specification Section.

1.07 DESIGN DATA

A. Submit simultaneously to the Design Agent for their knowledge as contract administrator and to the Owner.

B. Submit for information for the limited purpose of assessing conformance with the information given and the design concept expressed in the Contract Documents.

1.08 TEST REPORTS

A. Submit simultaneously to both the Owner and Design Agent.

B. Submit test reports for information for the limited purpose of assessing conformance with the information given and the design concept expressed in the Contract Documents.

1.09 CERTIFICATES

A. When specified in the individual specification Sections, submit certification by the manufacturer, installation/application subcontractor, or the Contractor to the Design Agent, in the quantities specified for the Product Data.

1. Indicate that the material or product conforms to or exceeds the specified requirements.

   Submit supporting reference data, affidavits, and certifications as appropriate.

2. Certificates may be recent or previous test results on the material or product, but must be

   acceptable to the Design Agent.

1.10 MANUFACTURER'S INSTRUCTIONS

A. When specified in the individual specification Sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to the Design Agent for delivery to the Owner in the quantities specified for Product Data.

B. Indicate the special procedures, and the perimeter conditions requiring special attention, and the special environmental criteria required for application or installation.

1.11 MANUFACTURER'S FIELD REPORTS

A. Submit reports simultaneously to the Design Agent's benefit as contract administrator and to the Owner.

B. Submit the report in duplicate within 30 days of observation to the Design Agent for information. C. Submit for information for the limited purpose of assessing conformance with the information given and the design concept expressed in the Contract Documents.

PART 2- PRODUCTS

PART 3- EXECUTION

END OF SECTION

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 -GENERAL

1.01 SECTION INCLUDES:

A. Quality control and control of installation.

B. Verification of Credentials and Licenses.

C. Tolerances.

D. References.

E. Testing.

1.02 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor a quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of the specified quality.

B. Comply with the manufacturers' instructions, including each step in sequence.

C. When the manufacturers' instructions conflict with the Contract Documents, request a clarification from the Design Agent before proceeding.

D. Comply with the specified standards as a minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform the Work by persons qualified to produce the required and specified quality.

F. Verify that field measurements are as indicated on the Shop Drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

H. See individual sections for mock-up requirements. Rebuild until accepted as a standard for the work.

1.03 VERIFICATION OF CREDENTIALS AND LICENSES

A. The Owner has implemented a project management oversight process and is applying it to current construction projects at CCRI.

B. An element of this oversight process is the verification that persons employed on the project site have appropriate and current credentials and licenses in their possession at the project site for the work they are performing.

C. Those persons without the appropriate credentials and licenses will be subject to dismissal from the project site.

1.04 TOLERANCES

A. Monitor the fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with the manufacturers' tolerances. When the manufacturers' tolerances conflict with the Contract Documents, request a clarification from the Design Agent before proceeding. Include the more rigorous tolerance requirements in the Base Bid.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.05 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by the date of issue current on the date of the Contract Documents, except where a specific date is established by code.

C. Obtain copies of the standards where required by the product specification sections.

D. When the specified reference standards conflict with the Contract Documents, request a clarification from the Design Agent before proceeding.

E. Neither the contractual relationships, duties, or responsibilities of the parties in the Contract, nor those of the Design Agent, shall be altered from the Contract Documents by mention or inference otherwise in reference documents.

1.06 TESTING

A Contractor to include all testing required by the work in connection with specification section requirements.

B. Contractor to include all testing or permit verifications required by local officials in order to complete the work.

PART 2- PRODUCTS

PART 3- EXECUTION

END OF SECTION

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 -GENERAL

1.01 SECTION INCLUDES

A. Temporary Utilities:
   1. Temporary electrical.
   2. Temporary lighting for construction purposes.
   3. Temporary water service.
   4. Temporary sanitary facilities.
   5. Hoisting.
   6. Parking / Traffic.
   7. Progress cleaning and waste removal.
   8. Security.
   9. Fire detection.
   10. Dust control.
   11. Noise control.
   12. Pollution control.
   13. Removal of utilities, facilities, and controls.

1.02 TEMPORARY ELECTRICITY

A. Provide flexible power cords as required for portable construction tools and equipment. All flexible power cords shall be suspended with hangers to eliminate trip hazards.

1.03 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain lighting for construction operations to achieve a minimum lighting level of 2 wat/sq ft (21 wat/sq m); 24 hours / 7 days

B. Maintain lighting and provide routine repairs.

1.06 TEMPORARY WATER SERVICE

A. The Owner will pay the cost of water used during construction. Exercise measures to conserve water. Utilize the Owner's existing water system. Extend and supplement with temporary devices as needed to maintain the specified conditions for construction operations.

1.07 TEMPORARY SANITARY FACILITIES

A. Contractors' personnel may use public restrooms within the facility provided that they take care to keep restrooms in maintained condition.

1.08 HOISTING

A. Contractor is responsible for all hoisting required to facilitate, serve, stock, clean, and complete the Work. Include all costs for Operating Engineers, fuel, delivery and removal, mobilization, staging, protection of grades and surfaces, and equipment.

B. Contractor may use scaffolding in lieu of lifts during the project at its own no cost option.

1.09 PARKING / TRAFFIC

A. Workers must park where directed by the College. Areas damaged by traffic or parking use must be restored to original condition at project completion.

B. Use of designated existing public parking lot is permitted. Tracked vehicles are not allowed on paved areas.

C. Do not allow heavy vehicles or construction equipment in parking areas.

D. Do not allow vehicle parking on existing sidewalks. Contractor is responsible for replacing sidewalks, roadway sections, and curbing to match that are damaged during construction.

E. Provide and maintain access to fire hydrants and control valves free of obstructions.

1.10 PROGRESS CLEANING AND WASTE REMOVAL

A. Maintain areas free of waste materials, debris, and rubbish. Maintain the work area in a clean and orderly condition.

B. Collect and remove waste materials, debris, and rubbish from the site daily, as necessary to prevent an on-site accumulation of waste material, debris, and rubbish, and dispose off-site.

C. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.14 SECURITY

A. Security Program:

1. Protect the Work, and the existing premises from theft, vandalism, and unauthorized entry.
2. Initiate the program in coordination with the Owner's existing security system at mobilization.
3. Maintain the program throughout the construction period until Owner occupancy of each designated area.
4. Contractor is responsible for all security within the work area and of the constructed enclosures and fencing serving it.

B. Entry Control: Coordinate the access of the Owner's personnel to the area in coordination with the Owner's security forces.

1.15 FIRE DETECTION

A. Before beginning any construction operation that can potentially trigger the existing fire alarm detection system, notify the Owner.

B. Failure to so notify the Owner will subject the Contractor to a monetary fine for each occurrence, should the fire detection system be activated inadvertently by a construction activity.

C. Comply with State underwriting standards and insurer recommendations for Hot Work, sprinkler impairment, and site maintenance.

D. Fire Protection system wok must be coordinated with CCRI's warrantee vendor and those costs included in the Base Bid.

1.16 DUST CONTROL

A. Execute the Work by methods to minimize raising dust from construction operations.

B. Provide positive means to prevent air-borne dust from dispersing into the building.

1.17 NOISE CONTROL

A. Provide methods, means, and facilities to minimize noise produced by the construction operations. Work only during agreed hours; 3rd shift (10:30 PM to 6:00 AM).

1.18 POLLUTION CONTROL

A. Provide methods, means, and facilities to prevent the contamination of soil, water, and the atmosphere from discharge of noxious, toxic substances, and pollutants produced by the construction operations.

1.19 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials, prior to Substantial Completion.

B. Clean and repair the damage caused by installation or use of temporary work.

C. Restore the existing and new facilities used during construction to their original condition.

PART 2- PRODUCTS

PART 3- EXECUTION

END OF SECTION

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 -GENERAL

1.01 SECTION INCLUDES

A. Transportation, handling, storage and protection.

B. Product option requirements.

C. Substitution limitations and procedures.

1.02 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by the Contract Documents.

B. Use only sustainably Harvested Wood products:

1. Definition: Wood-based materials include but are not limited to structural framing, dimension lumber, flooring, wood doors, finishes, and furnishings that are permanently installed in the project. Wood and wood-based products not permanently installed in the project are not included in the definition.

2. Specific Wood-Based Fabrications: Fabricate of sustainably harvested wood when so specified elsewhere.

3. Certification: Provide wood certified or labeled by an organization accredited by one of the following:

a. The Forest Stewardship Council, The Principles for Natural Forest Management; for Canada visit http://www.fsccanada.org, for the USA visit http://www.fscus.org.

2.02 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the 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 for any manufacturer not named.

PART 3 EXECUTION

3.01 TRANSPORTATION AND HANDLING

A Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

B. Transport and handle products in accordance with manufacturer's instructions.

C. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

F. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.02 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. If building storage is not available; storage is then only allowed within the area of disturbance.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

G. Prevent contact with material that may cause corrosion, discoloration, or staining.

H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

3.03 SUBSTITUTION PROCEDURES

A. Requests for substitutions must be submitted during the bidding period.

B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.

C. A request for substitution constitutes a representation that the submitter:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension that may subsequently become apparent.
5. Will reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.

D. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

E. Substitution Submittal Procedure:

1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
3. Rhode Island State Purchasing, thru the Addendum process; will provide a list of acceptable substitutions during the bidding process.

END OF SECTION

SECTION 01 70 00 - EXECUTION REQUIREMENTS

PART 1 -GENERAL

1.01 SECTION INCLUDES

A. Examination.
B. Preparation.
C. Field Engineering.
D. Protection of adjacent construction.
E. Cutting and patching.
F. Special procedures.
G. Starting and adjusting of systems.
H. Demonstration and Instructions.
I. Testing, adjusting and balancing.
J. Protecting Installed Construction.

1.02 EXAMINATION

A. Acceptance of Conditions:
   1. Verify that existing applicable site conditions, substrates, or substrate surfaces are acceptable or meet specific requirements of individual specifications Sections, for subsequent Work to proceed.
   2. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.
   3. Examine and verify specific conditions described in individual specifications sections.
   4. Verify that utility services are available, of correct characteristics, and in correct locations.
   5. Beginning of new work that relies upon the quality and proper execution of work of a preceding trade, means acceptance of that preceding work as appropriate for the proper execution of subsequent work.
   6. Acceptance of preceding work that can be shown later to have adversely affected proper performance of new work may result in removal and repeat performance of all work involved at no cost to the Owner.

1.03 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.
B. Seal cracks or openings of substrate prior to applying next material or substance.
C. Apply substrate primer, sealer, or conditioner, required or recommended by manufacturer, prior to applying any new material or substance in contact or bond.
D. Prior to the application, installation, or erection of any products and product components, performs any other preparatory operations, or surface or substrate modifications, as may be specified or directed by product manufacturers.

1.04 FIELD ENGINEERING -

Not Used

1.05 PROTECTION OF ADJACENT CONSTRUCTION

A. Protect existing adjacent areas and provide special protection where specified in individual Specification Sections.

B. Provide protective coverings at wall, projections, jambs, sills, and soffits of existing openings.

C. Protect existing finished floors, stairs, and other existing surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

D. Cover and protect furnishings, materials and equipment that are to remain within the spaces receiving new work. Move items as necessary to install new work and return them to original locations at the close of construction in that area.

E. Repair adjacent areas damaged by construction operations to original condition to the satisfaction of the Owner.

1.06 CUTTING AND PATCHING

A. Employ skilled and experienced installers to perform cutting and patching in the trades involved.

B. Provide cutting and patching work to properly complete the work of the project, complying with project requirements for:

1. Structural work.
2. Finish concrete.
3. Mechanical/electrical systems.
4. Visual requirements, including detailing and tolerances.
5. Operational and safety limitations.
6. Inspection, preparation, and performance.
7. Cleaning.

C. Do not cut and patch in a manner that would result in a failure of the work to perform as intended, decrease energy performance, increase maintenance, decrease operational life, or decrease safety performance.

D. Submit written request in advance of cutting or altering elements which affect:

1. Structural integrity of element.
2. Integrity of weather-exposed or moisture-resistant elements.
3. Efficiency, maintenance, or safety of element.
4. Visual qualities of sight-exposed elements.
5. Existing construction, or work of separate contractor.

E. Execute cutting, fitting, and patching including excavation and fill, to complete work, and to:

1. Fit the several parts together, to integrate with other work.
2. Uncover Work to install or correct ill-timed work.
3. Remove and replace defective and non-conforming work.
4. Remove samples of installed work for testing.
5. Provide openings in elements of work for penetrations of mechanical and electrical

work.

6. Fill and repair obsolete openings of relocated utilities.

F. Inspect conditions prior to work to identify scope and type of work required. Protect adjacent work. Notify Owner of work requiring interruption to building services or Owner's operations.

G. Execute Work by methods that will avoid damage to other work, and provide proper surfaces to receive patching and finishing.

1. Cutting: Use cutting tools, not chopping tools. Make neat holes. Minimize damage to adjacent work. Inspect for concealed utilities and structure before cutting.
2. Patching: Make patches, seams, and joints durable and inconspicuous. Comply with tolerances for new work. Match adjacent existing materials for fit and finish.

H. Cut masonry, concrete, and other rigid materials using masonry saw or core drill.

I. Remove ceiling material as necessary to access areas of work. Store and replace carefully to avoid damage. Replace all ceiling areas damaged during the work with new material to match.

J. Restore Work with new Products in accordance with requirements of Contract Documents.

K. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces.

L. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.

M. At penetration of fire rated partitions, ceiling, or floor construction, completely seal voids with fire rated or fire resistant material in accordance with Specifications, to full thickness of the penetrated element.

N. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.

0. Identify any hazardous substance or conditions exposed during the work to the Owner and Design Agent for decision or remedy.

P. Clean work area and areas affected by cutting and patching operations.

Q. See General Conditions for additional requirements.

1.07 SPECIAL PROCEDURES

A. Materials: As specified in product Sections; match existing with new products, or salvaged products as appropriate, for patching and extending work.

B. Employ skilled and experienced installer to perform alteration work.

C. Cut, move, or remove items as necessary for access to alterations and renovation work. Replace and restore at completion.

D. Remove unsuitable material not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.

E. Remove debris and abandoned items from area and from concealed spaces.

F. Prepare surface and remove surface finishes to provide installation of new Work and finishes.

G. Close openings in exterior surfaces to protect existing Work from weather and extremes of temperature and humidity.

H. Remove, cut, and patch work in a manner to minimize damage and to provide means of restoring products and finishes to original or specified condition.

I. Refinish existing visible surfaces to remain in renovated rooms and spaces to specified

condition for each material, with a neat transition to adjacent finishes.

J. Where new work abuts or aligns with existing, provide a smooth and even transition. Patch work to match existing adjacent work in texture and appearance.

K. When finished surfaces are cut so that a smooth transition with new Work is not possible, terminate existing surface along a straight line at a natural line of division and submit recommendation to Design Agent for review.

L. Where a change of plane of 1/4 inch or more occurs, submit recommendation for providing a smooth transition to Design Agent for review.

M. Trim existing doors as necessary to clear new floor finish. Refinish trim as required.

N. Patch or replace portions of existing surfaces which are damaged, or showing other imperfections.

0. Finish surfaces as specified in individual product Sections, or as indicated on the Drawings.

1.08 STARTING AND ADJUSTING OF SYSTEMS

A. Coordinate schedule for starting and adjusting of various equipment and systems.

B. Notify Design Agent and Owner seven days prior to starting and adjusting of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.

D. Verify that tests, meter readings and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute starting and adjusting under supervision of responsible contractor's personnel or manufacturer's representative, in accordance with manufacturer's instructions.

G. Adjust operating products and equipment to ensure smooth and unhindered operation.

H. When specified in individual specifications Section, require manufacturer to provide authorized representative to be present at the site to inspect, check, and approve equipment or system installation prior to starting, and to supervise placing of equipment or system in operation.

I. Submit a written report in accordance with Section 014000 that equipment or system has been properly installed and is functioning correctly.

1.09 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

C. Utilize operation and maintenance manuals as basis for instruction. Review contents of manuals with Owners personnel in detail to explain all aspects of operation and maintenance.

D. Demonstrate start-up, operation, control, adjustment, trouble shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled or agreed upon times, at equipment or system location.

E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

1.10 TESTING, ADJUSTING, AND BALANCING

A. If required by Owner; submit, for the Owner's approval, the name of an independent firm to perform testing of fire systems. The independent firm's services will be paid for by the Contractor.

B. The independent firm will perform services specified in individual specifications Sections.

C. Reports will be submitted by the independent firm to the Design Agent and the Owner indicating observations and test results, indicating compliance or non-compliance with specified requirements and with the requirements of the Contract Documents.

1.11 PROTECTING INSTALLED CONSTRUCTION

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. Repair or replace installed work damaged by construction operations, as directed by the Design

Agent.

PART 2- PRODUCTS -

NOT USED

PART 3- EXECUTION-

NOT USED

END OF SECTION

SECTION 01 73 20 - WASTE MANAGEMENT

PART 1 -GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:

1. Aluminum and plastic beverage containers.
2. Corrugated cardboard.
3. Wood pallets.
4. Clean dimensional wood: May be used as blocking or furring.
5. Land clearing debris, including brush, branches, logs, and stumps.
6. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
7. Glass.
8. Gypsum drywall and plaster.
9. Plastic buckets.
10. Paper, including wrapping, newsprint, and office.
11. Concrete.

E. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, incineration, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports. Submit in accordance with Section 013300.

F. Contractor shall develop and follow a Waste Management Plan designed to implement these requirements.

G. Methods of trash/waste disposal that are not acceptable are:

1. Burning on the project site.
2. Burying on the project site.
3. Dumping or burying on other property, public or private.
4. Other illegal dumping or burying.

H. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 RELATED REQUIREMENTS

A. Section 013000 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. Section 01 5000 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.

C. Section 016000 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.

D. Section 017000 - Execution Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

1.03 DEFINITIONS

A. Clean: Untreated and unpainted; Not contaminated with oils, solvents, caulk, or the like.

B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosively, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosively, toxicity, or reactivity.

E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

I. Return: To give back reusable items or unused products to vendors for credit.

J. Reuse: To reuse a construction waste material in some manner on the project site.

K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. Toxic: Poisonous to humans either immediately or after a long period of exposure.

0. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.04 SUBMITTALS

A. See Section 013300 for submittal procedures.

B. Waste Management Plan: Include the following information:

1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
6. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.

C. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.

1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
2. Submit Report on a form acceptable to Owner.
3. Landfill Disposal: Include the following information:
   a. Identification of material.
   b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
   c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
   d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
4. Incinerator Disposal: Include the following information:
   a. Identification of material.
   b. Amount, in tons or cubic yards, of trash/waste material from the project delivered to incinerators.
   c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
   d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
5. Recycled and Salvaged Materials: Include the following information for each:
   a. Identification of material, including those retrieved by installer for use on

other projects.

b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.

c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.

d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.

e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.

6. Material Reused on Project: Include the following information for each:

a. Identification of material and how it was used in the project.

b. Amount, in tons or cubic yards.

c. Include weight tickets as evidence of quantity.

7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 2 PRODUCTS- NOT USED

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

A. See Section 011000 for list of items to be salvaged from the existing building for relocation in project or for Owner.

B. See Section 013000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.

C. See Section 015000 for additional requirements related to trash/waste collection and removal facilities and services.

D. See Section 016000 for waste prevention requirements related to delivery, storage, and handling.

E. See Section 017000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.

B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Design Agent.

C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

D. Meetings: Discuss trash/waste management goals and issues at project meetings.

1. Pre-bid meeting.

2. Pre-construction meeting.
3. Regular job-site meetings.

E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.

1. Provide containers as required.
2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

SECTION 01 78 00 - CLOSEOUT SUBMITTALS

PART 1 -GENERAL

1.01 SECTION INCLUDES

A. Project Record Documents.

B. Operation and Maintenance Data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 013000- Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Individual Product Sections: Specific requirements for operation and maintenance data.

C. Individual Product Sections: Warranties required for specific products or work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Design Agent with claim for final Application for Payment.

1. Submit (2) electronic copies and (3) print copies of all documents.

B. Operation and Maintenance Data:

1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of work. Design Agent will review draft and return one copy with comments.

2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.

3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Design Agent comments. Revise content of all document sets as required prior to final submission.

4. Submit two sets of revised final documents in final form within 10 days after final inspection.

C. Warranties and Bonds:

1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.

2. Make other submittals within 10 days after Date of Substantial Completion, prior to final

Application for Payment.

3. For items of work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS- NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each product section description of actual products installed including the following:
   1. Changes made by Addenda and modifications.

F. Record Drawings: Legibly mark each item to record actual construction including:
   1. Field changes of dimension and detail.
   2. Details not on original Contract drawings.
   3. R.F.I.s
   4. Approved changes.

3.02 MAINTENANCE DATA

A. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

3.03 MAINTENANCE MANUALS

A. Prepare data in the form of an owner's manual.

B. Binder: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size.

C. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
   1. Part 1: Directory, listing names, addresses, and telephone numbers of Design Agent, Contractor, Subcontractors, and major equipment suppliers.
   2. Part 2: Maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:
      a. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

3. Part 3: Project documents and certificates, including the following:
   a. Shop drawings and product data.
   b. Photocopies of warranties and bonds.

3.04 WARRANTIES AND BONDS

A. Warranty period shall commence at date of substantial completion.

B. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.

C. Verify that documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals when required.

E. Retain warranties and bonds until time specified for submittal.

F. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.

END OF SECTION

01 80 00 - SPECIAL CONDITIONS

1. PROJECT SITE

Physics & Engineering Labs & Support Rooms
Community College of Rhode Island
Knight Campus
400 East Avenue
2nd Floor
Warwick, RI 02886

2. VISIT TO THE SITE

A. Each bidder is to visit the site, view the existing areas and acquaint himself with all of the conditions under which the work is to be performed. Failure of the Contractor to acquaint himself with all the conditions involved will not relieve him from fulfilling the Contract in all its details.

3. SIGNS

A. **No signs will be allowed to be displayed** on the site, on the building, or within the building except for safety signs.

4. DRAWINGS

A. Architectural drawings shall have precedence over all other drawings. Architect shall make final decision when precedence is questioned.

B. All work drawn on Plans and not specified, or all work specified and not drawn are part of Contract Work required to be completed and are to be executed as fully as if described in both of these ways. Only work specifically noted in the following manner shall be considered as not being in the contract.

"...by Owner"

"...NIC" (Not In Contract)

C. If, after examination of Contract Drawings and Specifications, or after a visit to the premises, any discrepancies, omissions, ambiguities, or conflicts are found in or about Contract Documents or there is doubt as to their meaning, Architect is to be notified at the earliest possible date prior to the Bid Opening. Where information sought is not clearly indicated or specified, the Architect shall issue an addendum to the Bidders clarifying conditions. The addendum shall become part of the Contract Documents. Neither the Owner nor the Architect shall be responsible for any oral instructions.

D. If there are two ways and/or instruction in drawings and/or specifications, it shall be assumed that the Contractor has based his base bid price on the most expensive way.

E. If duplication is shown on drawings and/or specifications of work by more than one trade, it is up to the Contractor bidding the Project to assign competent trades to install the work, with the exception that all A/V work is to be installed by a certified A/V contractor.

5. MAIN ENTRANCE RAMP

A. Main ramp from exterior of building to second floor entrance is not to be used by Contractor for deliveries and movement of equipment & materials. Deliveries to and from construction area to be brought up by elevator at the Loading Dock or interior ramps.

END OF SECTION

01 81 00 – CLEANING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Work Included: Throughout the construction period, maintain the building and site in a standard of cleanliness as described in this Section.

B. Related Work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
2. In addition to standards described in this Section, comply with requirements for cleaning as described in pertinent other sections of these specifications.
3. Consult the individual sections of the specifications for cleaning of Work installed under those sections.

1.02 QUALITY ASSURANCE:

A. Conduct daily inspection, and more often if necessary, to verify that requirements for cleanliness are being met.

B. In addition to the standards described in this section, comply with pertinent requirements of governmental agencies having jurisdiction.

1.03 RESPONSIBILITIES OF THE CONTRACTOR:

A. The General Contractor shall be responsible for the work of this Section, however, each subcontractor engaged upon the work shall bear his/her full responsibility in cleaning up immediately each day upon completion of his work in accordance with the provisions of this Section or other applicable Sections of the Specifications and shall cooperate with the Contractor to that effect.

B. The above shall in no way be construed to relieve the Contractor of his responsibility for leaving all work in a clean and proper condition, satisfactory to the Owner and the A/E.

C. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1.04 REQUIREMENTS OF REGULATORY AGENCIES:

A. Safety Standards: Maintain project in accordance with the following safety and insurance standard: Federal Occupational Safety and Health Act - Latest Edition.

B. Fire Protection: Store volatile waste in approved metal containers, and remove from premises daily.

C. Pollution Control: Conduct clean-up and disposal operations to comply with local ordinances and anti-pollution laws.

1. Burning or burying of rubbish and waste materials on project site is not permitted.
2. Disposal of volatile fluid wastes (such as mineral spirits, oil or paint thinner) in storm sanitary sewer systems or into streams or waterways is not permitted.

PART 2 - PRODUCTS:

2.01 CLEANING MATERIALS:

A. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

B. Use cleaning materials only on surfaces recommended by cleaning materials manufacturer.

PART 3 - EXECUTION

3.01 DURING CONSTRUCTION:

A. Oversee cleaning and insure that building and grounds are maintained free from accumulations of waste material and rubbish.

B. Sprinkle dusty debris with water and calcium chloride as needed. Calcium chloride shall be utilized only as directed by the Architect.

C. Contractor responsible for cleaning the hallway and other public spaces impacted by construction activities twice daily and at the request of the owner. Construction debris and dust may not accumulate in hallways.

D. At reasonable intervals daily, during the progress of work, clean-up site and access and dispose of waste materials, rubbish and debris.

E. Do not allow waste material, rubbish and debris to accumulate and become an unsightly or hazardous condition.

F. Remove waste materials, rubbish and debris from the site and legally dispose of at public or private dumping areas off the Owner's property.

G. Vacuum clean interior building areas when ready to receive finish painting and continue vacuum cleaning on an as-needed basis until building is ready for acceptance or occupancy.

H. Lower waste materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.

I. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet newly painted surfaces.

J. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.

1. Do not burn or bury rubbish and waste materials on project site.

2. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
3. Do not dispose of wastes into streams or waterways.

K. Provide on-site containers for collection of waste materials and rubbish.

L. Vacuum-clean interior building area when ready to receive finish painting and continue vacuum cleaning on an as-needed basis until Substantial Completion.

3.02 FINAL CLEANING:

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Prior to submitting a request to the Architect to certify Substantial Completion of the Work the Contractor shall inspect all interior and exterior spaces and verify that all waste materials, rubbish, tools, equipment, machinery and surplus materials have been removed and that all sight exposed surfaces are clean. Leave the Project clean and ready for occupancy.

1. Employ experienced workmen or professional cleaners for final cleaning
2. Clean Project site in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
3. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
4. Remove tools, construction equipment, machinery, and surplus material from Project site.
5. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
6. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, and similar spaces.
7. Sweep concrete floors broom clean in unoccupied spaces.
8. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
9. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
10. Remove labels that are not permanent.
11. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
12. Repair, patch and touch-up marred surfaces to the specified finish match adjacent surfaces
13. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
14. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
15. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

16. Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.
17. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
18. Leave Project clean and ready for occupancy. Maintain cleaning until the building or portion thereof is occupied by the Owner

C. At completion of construction and just prior to acceptance or occupancy, conduct a final inspection of exposed exterior and interior surfaces.

D. Unless otherwise specified under other sections of the Specifications, the Contractor shall perform final cleaning operations as herein specified prior to final inspection.

E. Cleaning shall include all surfaces, interior and exterior, which the Contractor has had access to, whether new or existing.

F. Use only cleaning materials recommended by the manufacturer of the surface to be cleaned. Use cleaning materials which will not create a hazard to health or property and which will not damage surfaces.

G. All broken or defective glass caused by the Contractor's Work shall be replaced at the expense of the Contractor.

H. Remove grease, mastic, adhesive, dust, dirt, stains, labels, fingerprints and other foreign materials from sight-exposed interior and exterior surfaces. This includes cleaning of the Work of all finishing trades where needed, whether or not cleaning by such trades is included in their respective specifications.

I. Any damage to finishes caused by cleaning operations shall be repaired at the Contractor's expense.

J. Owner's responsibility for cleaning commences at the time designated on the Certificate of Substantial Completion.

END OF SECTION

01 82 00 - PROTECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Refer to Section 015000 Temporary Facilities and Controls

B. Any damage to buildings, roads, public roads, bituminous concrete areas, fences, lawn areas, trees, shrubbery, poles, underground utilities, etc. shall be made good by and at the Contractor's own expense, all to the satisfaction of the Owner. The Contractor shall patch, repair and/or replace all adjacent materials and surfaces damaged after the installation of new work at no expense to the Owner. All repair and replacement work shall match the existing in kind and appearance.

PART 2 – PRODUCTS (Not Used):

PART 3 - EXECUTION (Not Used)

END OF SECTION

01 83 00 - DEMOLITION AND REPAIR

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included: Carefully demolish and remove from the building and site those items specified to be demolished and removed. Provide patching and repairs to all surfaces as indicated and as required for a complete and proper job.

B. Demolition shall not begin within the construction area or any other portions of the job site until all materials needed to complete the affected areas have been delivered to the job site.

C. Scope: The demolition and repair work generally consists of, but is not necessarily limited to that work described and shown on the drawings:

1. The work of this section also consists of, but is not necessarily limited to that work described in Section 01 10 00, Summary of the Work and elsewhere herein.

D. Related Work:

1. Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these specifications.
2. Section 01 85 00: Cutting and Patching.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

PART 2 - PRODUCTS

2.01 GENERAL

A. Match existing materials unless otherwise specified.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS:

A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 DEMOLITION

A. By careful study of the Contract Documents, determine the location and extent of selective demolition and repairs to be performed.

B. Prepare and follow an organized plan for demolition and removal of items:

1. Shut off, cap, and otherwise protect existing utility lines.

2. Completely remove items scheduled to be so demolished and removed, leaving surfaces clean, solid, and ready to receive new materials specified elsewhere.

3. In all activities, comply with pertinent regulations of governmental agencies having jurisdiction.

C. The Contractor shall be responsible for the removal and disposal of all materials and equipment from the site and building during the project. Unless directed otherwise by the Owner, all demolition materials to be removed from the site shall be disposed of in accordance with applicable laws and regulations.

D. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

E. Demolished material shall be considered to be the property of the Contractor unless Owner otherwise directs Contractor, and shall be completely removed from the job site. The Contractor shall, prior to any removal of rubbish from the site, furnish written evidence satisfactory to the Architect and/or Owner, that he has disposed of all debris from his demolition in an approved dumping location. **Owner shall have first right of refusal of any and all materials and equipment scheduled for removal.**

F. All demolition work shall be carried on in such a manner that the existing building and site and their component parts will not be damaged. Any damage to the building shall be corrected by the Contractor, to the satisfaction of the Owner and Architect, at no additional cost to the Owner.

G. Demolition of any of the material to be removed shall be carefully scheduled so that no portion of the buildings shall remain unprotected from the weather when work is not in progress. The Contractor and/or Subcontractor shall have on hand at all times, temporary covers and other materials to make weather tight areas that may be without protection in the event of a sudden shower, snowfall, freezing weather, etc.

3.02 REPLACEMENTS

A. In the event of demolition of items not so scheduled to be demolished, promptly replace such items to the approval of the Architect and at no additional cost to the Owner.

3.03 CUTTING, PATCHING, REPAIR

A. Patch and repair all surfaces damaged as a result of the work of this Contract. When completed, patches or repairs shall not be visible to the naked eye from a distance of 6 feet.

END OF SECTION

01 84 00 - PERMITS AND FEES

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall apply for, obtain and pay for all required permits and fees and shall arrange and schedule all inspections required.

B. No work shall begin until all pertinent permits are obtained.

C. The building permit shall be posted in a location that is protected from the weather and clearly visible from the exterior of the building.

D. The Contractor shall submit a copy of the building permit to the Architect and Owner prior to the start of the work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 05500 METAL FABRICATIONS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Work included: Provide metal fabrication work where shown on the drawings, as specified herein, and as needed for a complete and proper installation. Work generally includes:

1. Fasteners
2. Stainless steel
3. Miscellaneous metal materials and accessories

1.02 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Perform shop and/or field welding required in connection with the work of this Section in strict accordance with pertinent recommendations of the American Welding Society.

1.03 SUBMITTALS:

A. Comply with pertinent provisions of Section 01300.

1.04 PRODUCT HANDLING:

A. Comply with pertinent provisions of Section 01600.

PART 2 - PRODUCTS

2.01 MATERIALS (General)

A. In fabricating items which will be exposed to view, limit materials to those which are free from surface blemishes, pitting, rolled trade names, and roughness.

B. Comply with the following standards, as pertinent to the project:

ASTM A36	- Steel plates, shapes and bars
ASTM A283	- Grade C - Steel plates to be bent or cold-formed
ASTM A501	- Steel tubing (hot formed, welded or seamless)
ASTM A306	- Grade 65 or ASTM A36 - Steel bars and bar size shapes
ASTM A108	- Cold finished steel bars
ASTM A336	- Cold rolled carbon steel sheets
ASTM A526	- Galvanized carbon steel sheets
ASTM A525	- (with G90 zinc)

AISI, Type 302, or 304	- 22 ga. with No. 4 finish unless otherwise specified on the drawings or herein.
ASTM A53	- Gray iron castings, Grade A, Sched. 40; black finish unless otherwise noted.
ASTM A47	- Malleable iron castings
ASTM A53	- Steel pipe, Grade A, Sched. 40; black finish unless otherwise noted.

2.02 FASTENERS:

A. General:

1. For use where built into exterior walls, provide zinc-coated fasteners.
2. Provide fasteners of type, grade and class required for the particular use.
3. Use compatible fastening materials. Use only hot-dipped galvanized metal, copper or stainless steel fasteners where used in conjunction with preservative-treated wood.

B. Comply with the following standards as pertinent to the project:

1. Bolts and nuts; provide 4 hexagon-head, regular type complying with ASTM A307, Grade A.
2. Lag Bolts; provide spare-head type, complying with Fed. Spec. FF-B-561.
3. Machine Screws; provide cadmium plated steel type complying with Fed. Spec. FF-S-111.
4. Security Fasteners:

   a) Hex-Pin® button-head, flat-head and expansion security bolts, 316 stainless steel complying with ASTM F593-01.

5. Concrete Inserts:

   a) Threaded or wedge type galvanized ferrous castings of malleable iron complying with ASTM A27.
   b) Provide required bolts, shims and washers; hot-dip galvanized in accordance with ASTM A153.

6. Washers:

   a) Plain Washers; comply with Fed. Spec. FF-W-92, round carbon steel.
   b) Lock Washers; comply with Fed. Spec. FF-W-84, helical spring type carbon steel.

7. Toggle Bolts; provide type, class and style needed complying with Fed. Spec. FF-B-588.
8. Anchorage Devices; provide expansion shield complying with Fed. Spec. FF-S-325

2.03 STAINLESS STEEL:

A. Stainless Steel Kick Plates:

1. Stainless steel shall be fabricated of 16 gauge stainless steel, Type 302.
2. Formed of one sheet of metal.
3. Ground, and polished to a satin finish.
4. Corners and edges shall have radius corners.
5. Shop-fabricate entire kick plate assembly to suit door and door hardware configuration.

2.04 OTHER MATERIALS:

A. All other materials as needed for a complete and proper installation.

2.05 SHOP PAINT:

A. Primer: Use "10-99 Tnemec Primer", "Rustoleum #5769 Primer" or equal.

B. For repair of galvanizing use a high zinc dust content paint complying with MIL-P-21035.

C. Clean surfaces in accordance with Steel Structures Painting Council Sp-3, "Power Tool Cleaning".

D. After surfaces are properly cleaned, apply the primer to a uniform 1.5 mils. dry thickness.

2.06 FABRICATION:

A. Except as otherwise shown on the drawings or the approved shop drawings, use materials or size, thickness and type required to produce reasonable strength and durability in the work of this section.

B. Fabricate with accurate angles and surfaces which are true to the required lines and levels, grinding exposed welds smooth and flush, forming exposed connections with hairline joints and using concealed fasteners wherever possible.

C. Prior to shop painting or priming, properly clean metal surfaces as required for the applied finish for the proposed use of the item.

D. On surfaces inaccessible after assembly or erection, apply two coats on the specified primer. Change color of second coat to distinguish it from the first.

E. Galvanizing where indicated or specified shall be performed after fabrication. Shapes, plates and bars shall be galvanized in accordance with the requirements of "Standard Specifications for the Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strips" ASTM Designation A 123-71. Nuts, bolts, and washers shall be galvanized in accordance with the requirements

of "Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware" ASTM Designation A 153-71 and A286. All galvanized material shall comply with specifications and marked with stamp indicating ASTM number and weight of zinc coating in ounces per square foot similar to Duncan Stamp. Notarized statement of compliance with list of galvanized items to accompany shipment of galvanized materials and furnished to A/E.

F. Dissimilar Material: Where aluminum surfaces come in contact with metals other than stainless steel, zinc, white bronze of small area or other metals compatible with aluminum, aluminum surfaces shall be kept from direct contact with such parts by painting the dissimilar metal with a coating of zinc chromate paint, a good quality caulking placed between aluminum and dissimilar metal, or a non-absorptive tape or gasket.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 COORDINATION:

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this section.

3.03 INSTALLATION:

A. General:

1. Set work accurately into position, plumb, level, true and rack-free.
2. Anchor firmly into position.
3. Where field welding is required, comply with AWS recommended procedures of manual-shielded metal-arc welding for appearance and quality or weld and for methods to be used in correcting welding work.
4. Grind exposed welds smooth and touch-up shop prime coats.
5. Do not cut, weld or abrade surfaces which have been hot-dip galvanized after fabrication and which are intended for bolted or secreted field conditions.

B. Immediately after erection, clean the field welds, bolted connections, and abraded areas of shop priming. Paint the exposed areas with the same materials used for shop priming.

END OF SECTION

SECTION 06 10 00 ROUGH CARPENTRY

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Work Included: Provide wood, nails, bolts, screws, framing anchors, rough hardware, and other such items needed to perform rough carpentry for the construction shown on the drawings, as specified herein, and as needed for a complete and proper installation.

B. Related Work:

1. Documents affecting work of this section including but not necessarily limited to General Conditions, Supplementary Conditions, and sections in Division 1 of these Specifications.

1.02 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. Lumber Grading Rules and Wood Species to be in conformance with Voluntary Product Standard PS 20-70. Grading Rules of the following associations apply to materials furnished under this section.

1. Northeastern Lumber Manufacturer's Association, Inc. (NELMA)
2. Southern Pine Inspection Bureau (SPIB)
3. West Coast Lumber Inspection Bureau (WCLIB)
4. Western Wood Products Association (WWPA)
5. Redwood Inspection Service (RIS)
6. Northern Hardwood and Pine Manufacturer's Association (NHPMA)

C. Plywood Grading Rules:

1. Softwood plywood/Construction and Industrial:
Product Standard PS 1-66

D. Grade Marks: Identify all lumber and plywood by official grade marks.

1. Lumber: Grade stamp to contain symbol of grading agency, mill number or name, grade of lumber, species or species grouping or combination designation, rules under which graded, where applicable and condition of seasoning at time of manufacture.

a) S-GRN: Unseasoned
b) S-Dry: Maximum 19% moisture content
c) MC-15 or KD: Maximum of 15% moisture content
d) Dense.

2. Softwood Plywood: Appropriate grade trademark of the American Plywood Association.

   a) Type, grade, class, and identification index.
   b) Inspection and testing agency mark.

E. Testing: ASTM E 84-70, maximum 25 flame spread rating (exposed wood only).

F. All Lumber: Preservative treated or fire retardant, as directed on the drawings and herein.

G. Requirements of Regulatory Agencies:

1. Fire Hazard Classification: Underwriters' Laboratories, Inc., for treated lumber and plywood.
2. Preservative Treated Lumber and Plywood: American Wood Preserver Bureau, Quality mark.
3. Pressure Treated Material: American Wood Preservers Bureau Standards.
4. Span Tables: National Forest Products Associations.
5. Working Stresses: Softwood Lumber, National Design Specification, National Forest Products Association.

1.03 SUBMITTALS

A. Certification:

1. Preservation Treated Wood: Submit certification for waterborne preservative that moisture content was reduced to 19% maximum, after treatment.
2. Fire-retardant Treatment: Submit certification of treating plant that fire-retardant treatment materials comply with governing ordinances and that treatment will not bleed through finished surfaces.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Immediately upon delivery to job site, place materials in area protected from weather.

B. Store materials a minimum of 6" above ground on framework or blocking and cover with protective waterproof covering providing for adequate air circulation or ventilation.

C. Do not store seasoned materials in wet or damp portions of building.

D. Protect fire-retardant materials against high humidity and moisture during storage and erection.

E. Protect sheet materials from corners breaking and damaging surfaces while unloading.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide materials in the quantities needed for the work shown on the drawings, and meeting or exceeding the following standard of quality:

1. Plywood:

   a) Sheathing: PA Structural I or II, C-C standard sheathing, standard exterior grade sheathing with exterior glue. Use plywood specifically extended for exterior use.
   b) Softwood Plywood: PS 1; use G-D grade with exterior glue. Use plywood specifically intended for exterior use.
   c) Strapping: Shall be 1" × 3" spruce wood furring.

2. Lumber: PS 20; graded in accordance with established Grading rules.

   a) Structural Light Framing: Southern Yellow Pine No. 2 grade and better.
   b) Non-structural Light Framing: Southern Yellow Pine No. 2 grade and better.
   c) Horizontal framing members: Southern Yellow Pine, Table 1, Construction grade.
   d) Vertical framing members: Southern Yellow Pine, Table 1, Standard grade.

3. Laminated-veneer lumber (LVL):

   a) Materials shall comply with ICC ES ESR-1387.
   b) Adhesives shall be of the waterproof type conforming to the requirements of ASTM D-2559.
   c) LVL shall be equal to Microllam® as manufactured by Weyerhaeuser in a plant listed in the reports referred to above and under the supervision of an approved third-party inspection agency. It shall be manufactured in a continuous process with all grain parallel with the length of the members. All members are to be free of finger or scarf joints or mechanical connections in full-length members.
   d) LVL shall be identified by a stamp indicating the product type and grade and ICC ES evaluation report number, manufacturer's name, plant number and the independent inspection agency's trademark.

4. Dimensions:

   a) Specified lumber dimensions are nominal.
   b) Actual dimensions conform to industry standards established by the American Lumber Standards Committee and the rules writing agencies.
   c) Tolerances for laminated-veneer lumber:
      1) Finished Length (as specified): ± 1/4"
      2) Width/Depth ≤ 3.5" wide / ≤ 14" deep: ± 1/8"
         > 3.5" wide / > 14" deep: ± 3/16"

5. Moisture Content: Unseasoned or 19% maximum at time of permanent closing in of building or structure, for lumber 2" or less nominal thickness.

6. Surfacing: Surface four sides (S4S), unless specified otherwise.
7. Framing Lumber: 2" to 4" thick, 2" to 4" wide, any commercial softwood specified:

   a) Light Framing:

      1) Plates, blocking, bracing, and nailers: Utility Grade.
      2) Bracing, blocking, bulk headings, and general utility purposes: Economy Grade.
      3) Grade: Appearance
      4) Grade: Appearance, 15% maximum moisture content, MC-15 or KD on grade stamp.

8. NOTE: Southern yellow pine of similar quality may be utilized, particularly with preservative treatment.

B. Building Paper: FS UU-B-790A, Type 1, width of 36" or as specified on the drawings.

C. Fire-retardant treated products;

1. Lumber: AWPA C20-70
2. Plywood: AWPA C27-70

D. Preservative-Treated Wood Products:

1. Creosote and creosote preservatives for wood placed in ground or in water.

   a) AWPB LP-55, ground contact application creosote or creosote coal tar solution.
   b) Pressure treated – water borne preservatives – exposed woods above ground.
   c) AWPB LP-22
   d) Untreated Lumber: All heartwood grades.

2.02 OTHER MATERIALS:

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor, subject to the approval of the A/E.

PART 3 - EXECUTION

3.01 CONDITIONS OF SURFACES:

A. Verify that surfaces to receive rough carpentry materials are prepared to exact grades and dimensions.

B. Erect wood nailing members true to lines and levels. Do not deviate from true alignment more than 1/4 inch.

C. Space framing members at 16 inches on center unless otherwise directed on the drawings or herein.

D. Construct members of continuous pieces of longest possible lengths.

E. Use preservative treated wood in work involved with roofing, door, window blocking, and sills.

F. Provide edge, and roof opening blocking on top of existing deck surface or top of parapet unless otherwise directed on the drawings.

G. Provide vertical wood backing to parapets and metal fascia at roof perimeter and as directed on the Contract Documents.

H. Double-up wall framing members at openings over 100 square inches. Space short members above and below openings in same manner for walls.

3.02 DELIVERIES:

A. Stockpile materials sufficiently in advance of need to assure their availability in a timely manner for this work.

B. Make as many trips to the job site as are intended to delivery materials of this section in a timely manner to ensure orderly progress of the work.

3.03 INSTALLATION:

A. Pressure-treated Wood Products:

1. Provide pressure-treated wood for all framing, blocking, furring, nailing strips built into exterior masonry walls, wood in contact with concrete and in conjunction with gravel stops and roofing when applicable.
2. Re-dry and clean lumber, after treatment, to maximum moisture content of 19% stamped "DRY".
3. Apply two brush coats of same preservative used in original treatment to all sawed or cut surfaces of treated lumber.

B. Plywood Sheathing:

1. Placement:

a) Place plywood with face grain perpendicular to supports and continuously over at least two supports, except where otherwise shown on the drawings.
b) Center joints accurately over supports, unless otherwise shown on the drawings.

c) Place roof sheathing with end joints staggered. Secure sheets over firm bearing. Maintain minimum 1/16 inch and maximum 1/8 inch spacing between joints of sheets on walls. Place perpendicular to framing members.

2. Protect plywood from moisture by use of waterproof coverings until the plywood, in turn, has been covered with the next succeeding component or finish.

3.04 COMPLIANCE:

A. Do not permit materials not complying with the provisions of this section to be brought onto or to be stored or used at the job sites.

B. Promptly remove non-complying materials from the job site and replace with materials meeting the requirements of this section.

3.05 WORKMANSHIP:

A. Products joints which are tight, true, and well nailed, with members assembled in accordance with the drawings and with pertinent codes and regulations.

B. Selection of Lumber Pieces:

1. Carefully select the members.
2. Select individual pieces so that knots and obvious defects will not interfere with placing bolts or proper nailing, and will allow making of proper connections.
3. Cut out and discard defects which render a piece unable to serve its intended function.
4. Lumber may be rejected by the A/E, whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus, or mold, as well as for improper cutting and fitting.

C. Do not shim any framing component.

3.06 GENERAL FRAMING:

A. In addition to framing operations, normal to the fabrication and erection indicated on the drawings, install wood blocking and backing required for the work of other trades.

B. Set horizontal and sloped members with crown up.

C. Do not notch, cut, or bore members for pipes, ducts, or conduits, or for other reasons except as shown on the drawings or as specifically approved, in advance, in writing, by the A/E.

D. Bearings:

1. Make bearings full, unless otherwise indicated on the drawings.

2. Finish bearing surfaces on which structural members are to rest so as to give sure and even support.
3. Where framing members slope, cut or notch and end as required, to give uniform bearing surface.

3.07 BLOCKING:

A. Provide wood blocking as required for a complete and proper job and as required by the roofing manufacturer.

3.08 ALIGNMENT:

A. On framing members to receive a finished surface, align the finish subsurface to vary not more than 1/8" from the plane of surfaces of adjacent furring and framing members.

3.09 FASTENING:

A. Nailing:

1. All nailing shall comply with all requirements of the latest edition of the Rhode Island Building Code.
2. Nail without splitting wood.
3. Pre-bore as required.
4. Remove split members and replace with members complying with the specified requirements.

B. Bolting:

1. Drill holes 1/16" larger in diameter than the bolts being used.
2. Drill straight and true from one side only.
3. Don't bear bolt threads on wood, but use washers under head and nut where both bear on wood, and use washers under all nuts.

C. Screws: For lag screws and wood screws, pre-bore holes same diameter as root of threads, enlarging holes to shank diameter for length of shank. Use screws at all replacement plywood substrate at roofs.

D. **Use only galvanized metal, copper or stainless-steel fasteners in conjunction with preservative-treated wood. Use compatible fastening materials.**

3.10 CLEANING UP:

A. Remove all excess material from site.

END OF SECTION

SECTION 06 20 00 FINISH CARPENTRY

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Provide wood, nails, bolts, screws, framing anchors, other hardware, and other such items needed to perform finish carpentry for the construction specified on the drawings, as specified herein, and as needed for a complete and proper installation.

B. Related Work Described Elsewhere:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Codes and Standards:

1. In addition, comply with the pertinent codes and regulations of governmental agencies having jurisdiction unless otherwise specifically directed or permitted by the A/E. also comply with:

a) "Plywood Specification and Grade Guide" of the American Plywood Association.
b) "Quality Standards" of the Architectural Woodwork Institute.

1.03 SUBMITTALS:

A. Comply with Section 013000.

B. Submit wood samples: 8" × 8" with specified finish for approval by Architect.

C. Manufacturers' recommended methods of installation which, when approved by the A/E, will become the basis for acceptance or rejection of actual installation procedures used on the work.

D. Materials list of items proposed to be provided under this section.

E. Shop drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this section with the work of adjacent trades.

PART 2 - PRODUCTS

2.01 GRADE STAMPS:

A. Identify framing lumber by the grade stamp of the West Coast Lumber Inspection Bureau, or such other grade stamp as is approved, in advance, by the A/E.

B. Identify plywood as to species, grade and glue-type by the stamp of the American Plywood Association.

C. Identify other materials of this section by the appropriate stamp of the agency approved, in advance, by the A/E.

D. Premium Grade for transparent finish, in accordance with applicable sections of the "Quality Standards Illustrated" of the Architectural Woodwork Institute, latest edition, conforming to the following section:

1. Section 100 - Solid Wood Members
2. Section 200 - Plywood and Particleboard
3. Section 300 - Standing and Running Trim
4. Section 400 - Casework
5. Section 1500 - Factory Finishing

E. All lumber shall be fire retardant.

F. Plywood blocking shall be APA Structural II, C-C, exterior glue Douglas Fir.

2.02 MANUFACTURERS:

A. Unless specifically otherwise approved by the Architect, provide all products of this section from a single millwork manufacturer.

2.03 FINISH CARPENTRY MATERIALS:

A. In general, comply with the following:

1. Softwood Lumber: PS 20; graded in accordance with the requirements of AWI; maximum moisture content of 6 percent for interior work and 10 percent for exterior work.
2. Hardwood Lumber: Graded in accordance with AWI; maximum moisture content of 6 percent; Birch species, Economy grade unless noted otherwise, herein.
3. Softwood Plywood: PS 1; graded in accordance with AWI; core material of lumber unless noted otherwise, herein.
4. Douglas Fir Plywood: Graded in accordance with AWI; core material of veneer unless noted otherwise, herein.
5. Hardwood Plywood: PS 51; graded in accordance with AWI; core material of lumber, Birch species, Economy grade and face veneer rotary cut and Random match unless noted otherwise, herein.

2.04 MOULDINGS:

A. Match existing configurations.

B. In accordance with:

1. Architectural Woodwork Institute, Wood Mouldings, "A Guide for Interior Architectural Design".
2. Western Wood Moulding and Millwork Producers, WM/Series, Wood Moulding Patterns, WM 4-77.
3. Forester Moulding & Lumber, Inc. Standard Profiles Catalogue.

C. Provide mouldings in accordance with pertinent drawings and notes.

2.05 FRAMING LUMBER & PLYWOOD:

A. Shall be in accordance with Section 06100, Rough Carpentry.

2.06 FASTENING:

A. Install items straight, true, level, plumb, and firmly anchored into position.

B. Where blocking or backing is required, coordinate as necessary with other trades to ensure placement of required blocking and backing in a timely manner.

C. Nail trim with finish nails of proper dimension to hold the member firmly in place without splitting the wood.

D. Nail exterior trim with galvanized nails, making joints to exclude water and setting in waterproof glue or the sealant described in Section 079200 of these Specifications.

E. On exposed work, set nails for putty.

2.07 OTHER MATERIALS:

A. Provide other materials not specifically described but required for a complete and proper installation, as selected by the Contractor, subject to the approval of the A./E.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS:

A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

B. Contractor shall field verify extent of finish carpentry work. Remove and dispose and provide new to match existing as necessary for a complete and proper installation.

3.02 DELIVERIES:

A. Stockpile materials sufficiently in advance of need to assure their availability in a timely manner for this work.

B. Make as many trips to the job sites as are needed to deliver materials of this section in a timely manner to ensure orderly progress of the work.

3.03 COMPLIANCE:

A. Do not permit materials not complying with the provisions of this section to be brought onto or to be stored at the job site.

B. Promptly remove non-complying materials from the job site and replace with materials meeting the requirements of this section.

3.04 WORKMANSHIP:

A. Install items straight, true, level, plumb, and securely anchored into position.

B. Sandpaper finished or backing is required, coordinate as necessary with other trades to assure placement of required blocking and backing in a timely manner.

1. Do not sand wood, if any, designated on the drawings as remaining rough.
2. No coarse-grained sandpaper marks, hammer marks, or other imperfections will be accepted.

C. Jointing:

1. Make joints to conceal shrinkage; miter exterior joints; cope interior joints; miter or scarf end-to-end joints.
2. Install trim in pieces as long as possible, jointing only where solid support is obtained.

3.05 CLEANING UP:

A. Keep the premises in a neat, safe and orderly condition at all times during the execution of this portion of the work; free from accumulations of sawdust, cut-ends, and debris.

B. Sweeping:

1. At the end of each working day, and more often if necessary, thoroughly sweep surfaces where refuse from this portion of the work has settled.
2. Remove the refuse to the area on the job sites set aside for its storage.
3. Upon completion of this portion of the work, thoroughly broom clean all surfaces.

3.06 BLOCKING:

A. Comply with Section 061000.

3.07 ALIGNMENT:

A. On framing members to receive a finished surface, align the finish subsurface to vary not more than 1/8" from the plane of surfaces of adjacent furring and framing members.

END OF SECTION

SECTION 07 92 00 SEALANTS AND CAULKING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Work Included: Throughout the work seal and caulk joints where shown on the drawings and elsewhere as required to provide a positive barrier against passage of moisture and passage of air.

B. All necessary packing and back-up material shall be provided at existing locations and as required for a complete and proper installation. Manufacturer's printed recommendations for the preparation of surfaces and handling, mixing and installation of caulking and sealing compounds shall be strictly followed.

C. Related Work:

1. Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.02 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

1.03 SUBMITTALS:

B. Comply with pertinent provisions of Section 013000.

C. Product Data: After the Contractor has received the Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this Section.
2. Manufacturer's specifications and other data needed to provide compliance with the specified requirements.
3. Manufacturer's recommended installation procedures which, when approved by the A/E, will become the basis for accepting or rejecting actual installation procedures used on the work.
4. Color samples.

D. Samples: Accompanying the submittal described above, submit samples of each sealant, each backing material, each primer, and each bond breaker proposed to be used.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Comply with pertinent provisions of Section 016000.

B. Do not retain or use at the job site, material which has exceeded the shelf life recommended by its manufacturer.

PART 2 - PRODUCTS

2.01 SEALANTS:

A. Except as otherwise specifically approved by the A/E, use only the types of sealants described herein.

B. For all joints at aluminum and aluminum-to-masonry: Sealing Compound; Tremco Spectrum 1-(1) part, moisture-curing silicone joint sealant.

C. For all joints at metal-to-glass: Sealing Compound; Tremco Spectrum 2- High-performance, neutral-cure, general-purpose silicone sealant.

D. For all joints at exterior masonry: Tremco Dymonic 100 1-part urethane sealant.

E. Caulking compound of the 1-part acrylic-type Tremco Tremflex 834 shall be used for sealing all joints on the building interior where "caulking" is indicated and required.

F. For other services, provide products especially formulated for the proposed use and approved in advance by the A/E.

G. Colors:

1. Colors for each sealant installation will be selected by the A/E from standard colors normally available from the specified manufacturers.
2. Should such standard color not be available from the approved manufacturer except at additional charge, provide such colors at no additional cost to the Owner.

H. In concealed installations and in partially or fully exposed installations where so approved by the A/E, use standard gray or black sealant.

2.02 PRIMERS:

A. Use only those primers which are non-staining, have been tested for durability on the surfaces to be sealed, and are specifically recommended for this installation by the manufacturer of the sealant used.

B. In general, use Tremco Primer "A" for porous surfaces, Primer B for non-porous surfaces. Provide in strict conformance with manufacturer's written instructions.

2.03 BACK-UP MATERIALS:

A. Use only those back-up materials which are specifically recommended for this installation by the manufacturer of the sealant used, which are nonabsorbent, and which are non-staining.

B. Backing: Joints shall be backed with a close-cell butyl or neoprene rod; with a minimum shore "A" of 70 unless otherwise noted elsewhere. A solid base shall be provided below the joint backing utilizing sand, multiple layers of joint backing, etc., in order to support the sealant. It is important that the backdrop material be of a type to which the sealant does not adhere in a working joint.

C. Acceptable Types Include:

1. Closed-cell resilient urethane or polyvinyl-chloride foam;
2. Closed-cell polyethylene foam;
3. Closed-cell sponge of vinyl or rubber;
4. Polycholooprene tubes or beads;
5. Polyisobutylene extrusions; and
6. Oil-less dry jute.

D. Do not block weep holes

2.04 BOND PREVENTATIVE MATERIALS:

A. Use only one of the following as best suited for the application, and as recommended by the manufacturer or the sealant used:

1. Polyethylene tape, pressure-sensitive adhesive, with the adhesive required only to hold tape to the construction materials as indicated.
2. Aluminum foil complying with MIL-A-148E.
3. Wax paper complying with Fed. Spec. UU-P-270.

2.05 MASKING TAPE:

A. For masking around joints, provide masking tape complying with Fed. Spec. UU-T-106c.

2.06 OTHER MATERIALS:

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the A/E.

PART 3- EXECUTION

3.01 SURFACE CONDITIONS:

A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION:

A. Concrete and Masonry Surfaces:

1. Install only on surfaces which are dry, sound, and well brushed, wiping free from dust.
2. At open joints, remove dust by mechanically blown compressed air, if so required.
3. Use solvent to remove oil and grease, wiping the surfaces with clean rags.
4. Where surfaces have been treated, remove the surface treatment by sandblasting, wire brushing or grinding.
5. Remove laitance and mortar from joint cavities.
6. Where backstop is required, insert the approved backup material into the joint cavity to the depth needed.
7. Joints and spaces filled with sealant greater in depth than the width of the joint shall be filled so that the depth of the joint shall be equal to the width of the joint. The depth of the joint shall not be less than 3/8". Packing for the joints shall be of the materials specified. Packing shall provide a firm back-up for the sealant via the manufacturer's written instructions.
8. Joints and spaces caulked with Tremco Dymonic sealant shall not be more than 3/8" wide by 3/8" deep. Minimum size of joints caulked shall be recommended by the manufacturer. Joints more than 3/8" in depth shall be packed as specified.
9. Color: As selected by the A/E.
10. Priming: As recommended by the sealant manufacturer.

B. Steel Surfaces in Contact with Sealant:

1. Sandblast as required or prepare surfaces in accordance with manufacturer written instruction to achieve acceptable surface for bond.
2. If sandblasting is not practical, or would damage adjacent finish, scrape the metal or wire brush to remove mill scale.
3. Use solvent to remove oil and grease, wiping the surfaces with clean rags.
4. Remove protective coatings on steel by sandblasting or by using a solvent which leaves no residue.

C. Aluminum Surfaces in Contact with Sealant:

1. Remove temporary protective coatings, dirt, oil, and grease.

2. When masking tape is used for protective cover, remove the tape just prior to applying the sealant.
3. Use only such solvents to remove protective coatings as are recommended for that purpose by the manufacturer of the aluminum work, and which are non-staining.

3.03 INSTALLATION OF BACK-UP MATERIAL:

A. Use only the back-up material recommended by the manufacturer of the sealant used, and approved by the A/E for the particular installation, compressing the back-up material 25% to 50% to achieve a positive and secure fit.

B. When using back-up tube or rod stock, avoid lengthwise stretching of the material. Do not twist or braid hose or rod back-up stock.

3.04 BOND-BREAKER INSTALLATION:

A. Provide an approved bond-breaker where recommended by the manufacturer of the sealant, and where directed by the A/E, adhering strictly to the installation recommendations as approved by the A/E.

3.05 INSTALLATION OF SEALANTS:

A. Prior to start of installation in each joint, verify the joint type according to details on the drawings, or as otherwise directed by the A/E, and verify that the required proportion of width of joint to depth of joint has been secured.

B. Equipment:
1. Apply sealant under pressure with power-actuated or hand gun, or by other appropriate means.
2. Use guns with nozzle of proper size and providing sufficient pressure to completely fill the joints as designed.

C. Thoroughly and completely mask joints where the appearance of sealant on adjacent surfaces would be objectionable.

D. Install the sealant in strict accordance with the manufacturer's recommendations as approved by the A/E, thoroughly filling joints to the recommended depth.

E. Tool joints to the profile shown on the drawings, or as otherwise required if such profiles are not shown on the drawings.

F. Cleaning Up:
1. Remove masking tape immediately after joints have been tooled.
2. Clean adjacent surfaces free from sealant as the installation progresses, using solvent or cleaning agent recommended by the manufacturer of the sealant used.

END OF SECTION

SECTION 08 11 00 STEEL FRAMES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Furnish and install standard hollow metal frames, sidelites, interior glazed assemblies and borrowed lites as specified or shown on plans and schedules.

B. Related Work Specified Elsewhere:

1. Documents affecting work of this section include, but are not necessarily limited to, General conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.02 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. Unless otherwise specifically approved by the Architect, provide all products of this section from a single manufacturer.

C. Where fire-rated assemblies are indicated or required, provide assemblies that comply with NFPA-80 and have been tested, listed and labeled in accordance with ASTM E-152 by a nationally recognized independent testing and inspection agency acceptable to the authorities having jurisdiction.

D. No product shall be manufactured prior to receipt of approved hardware information and templates.

E. Other Reference Standards:

1. American National Standards Institute (ANSI)

a) ANSI A115 series on door and frame preparation.

2. Steel Door Institute (SDI). Technical Data Series.
3. Federal Specification (FS) RR-O-5758, Type II, Heavy Duty, 1-3/4", Style 2, Full Flush, Hollow Steel Construction.

1.03 SUBMITTALS:

A. Comply with pertinent other provisions of Section 01300 which are not specifically described below.

B. Show glass opening sizes and locations in doors.

C. Detail connections of hollow metal work to structural steel framing concealed in hollow metal work.

D. Detail joints required to accommodate expansion joint movement.

E. Submit manufacturer's product technical data substantiating that products comply with requirements.

F. All openings shall be labeled with the Architect's door number NOT the shop "TAG" number.

G. Elevations and large scale dimensioned sections shall be provided for each door and frame type.

H. Indicate all hardware locations, gages, finishes and materials included in submittals.

I. Provide details showing anchors, wall conditions, and installation for each different condition.

J. Indicate coordination of glazing frames and stops with glass and glazing requirements.

K. Submit all necessary shop drawings to Architect for review of general conformance with the requirements of the Contract Documents, minimum (6) copies.

1.04 PRODUCT HANDLING:

A. Comply with pertinent other provisions of Section 01600 which are not specifically described below.

B. Products shall be marked at point of shipping with Architect's opening numbers.

C. Protect materials during shipment and storage.

D. Store doors and frames upright and spaced off the floor to prevent damage from standing water.

E. Inspect all materials upon receipt for damage and notify both shipper and supplier in writing of damage found. If acceptable to the Architect minor damage can be repaired, refinished.

1.05 WARRANTY

A. All materials shall be warranted to be free from defects in materials and workmanship for a period of one year (1) from the time of final completion of the project as defined in the general conditions.

PART 2 - PRODUCTS

2.01 MATERIALS (FRAMES):

A. Frames shall be combination buck, frame and trim type.

B. Minimum Gages: 16 ga., interior.

C. Brake-form steel sheets.

D. Frames in masonry shall have reinforced heads.

1. Provide profiles and shapes free of warp, buckles, fractures or other defects.
2. Form stops integral with frames unless otherwise shown.

E. Corners and connections shall be mitered and welded with exposed welds ground flush and smooth.

F. Anchors:

1. Provide an anchor at each jamb for each 2'-6" of door height or fraction thereof unless otherwise noted.
2. Vary anchor types to provide positive fastening to adjacent construction.
3. Secure a metal clip angle at bottom of each jamb member for anchoring to floor with a minimum of 2 fasteners.

G. All door frames shall be filled solid before installation with light weight aggregate plaster or mortar.

H. Provide and install rubber door silencers in all interior door frames. (Not less than two (2) silencers on the lock side of single doors, and one (1) silencer for each leaf in heads of double door frames).

2.04 LABELED FRAMES:

A. Frames designated to be labeled shall bear UL label.

B. Where label is not required, submit manufacturer's certificate that construction conforms to Testing Agencies' requirements for label indicated.

C. Furnish statement on label that construction provides the heat transmission rating of a maximum of 250°F in 30 minutes or as required on the drawings.

2.03 FINISHING:

A. Frames shall be leveled and ground smooth.

B. Apply mineral filler to eliminate weld scars and other blemishes.

C. Give factory coat of rust-inhibitive metal primer. Interior doors and frames shall receive a coat of air dry, vinyl base metal primer # MP-139 grey. Exterior doors and frames using G.90 zinc shall receive a coat of mixed air dried primers #DZ3 and #DLT16.

D. Paint all surfaces and edges of doors and frame assembly.

2.04 PREPARATION FOR FINISH HARDWARE:

A. Prepare doors and frames to receive hardware.

1. Hardware supplier shall furnish hollow metal manufacturer approved hardware include schedule, hardware templates, and samples of physical hardware where necessary to insure correct fitting and installation.
2. Preparation includes sinkage and cutouts for mortise and concealed hardware.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Install doors and frames in accordance with HMMA 840 and NFPA-80 to ensure fire ratings and proper operation of openings.

B. Set welded frames prior to wall construction and remove shipping spreaders before installation.

C. Follow manufacturer's instruction and apply hardware in accordance with hardware manufacturer's templates and written instructions.

D. Exercise care in setting of frames to maintain scheduled dimensions, hold head level and maintain jambs plumb and square.

E. Secure anchorages and connections to adjacent construction.

F. Wherever possible, leave frame spreader bars intact until frames are set perfectly square and plumb, and anchors are securely attached.

G. Secure frames to structural steel framing concealed in hollow metal work, and make field splices.

H. Allow for expansion movement as required.

I. Apply hardware in accordance with hardware manufacturer's templates and instructions.

J. Adjust operable door parts for correct function.

K. Remove hardware, with the exception of prime-coated items, tag, box, and reinstall after finish paint work is completed.

3.02 PRIME COAT TOUCH-UP:

A. Immediately after erection, areas where prime coat has been damaged shall be sanded smooth and touched up with the same primer as applies at shop.

B. Remove rust before above specified touch-up is applied.

C. Touch-up shall not be obvious.

D. Before job painting is started, finish on frame and doors shall comply with finish on approved same.

E. At the time of installation, remove and debris created as a result of unpacking or installation.

F. Prior to building turnover, make a final inspection for proper operation, fit and tolerances. Make all necessary adjustments.

3.03 PROTECTION:

A. Protect installed hollow metal work against damage from other construction work.

END OF SECTION

SECTION 08 21 20 WOOD DOORS AND FRAMES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This section covers all wood doors. Refer to Section 081000 for Steel Frame Specifications.

B. Related Work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.02 QUALITY ASSURANCE

A. Acceptable Manufacturers: Qualified to affix each door with National Woodwork Manufacturers' Association (NWMA), Seal of Approval or qualify certification stamp.

B. Requirements of Regulatory Agencies:

1. Underwriter's Laboratories, Inc. (UL), Fire Doors (120 IDO) for fire classification marking.
2. National Fire Protection Association (NFPA), "Standard fire Doors and Windows", NFPA No. 80 for installation of fire-rated doors.

C. Testing Requirements:

1. Adhesives - NWMA 1.S.I-69

a) Waterproof bond test for exterior doors (when applicable).
b) Water-resistant bond test for interior doors (when applicable).

2. Warp - NWMA 1.S.I-69

3. Fire Test: Underwriter's Laboratories, Inc., Standard UL 10(b), Fire Tests of Door Assemblies.

1.03 SUBMITTALS:

A. Samples: Submit samples showing face veneers and finish

B. Shop Drawings - Show details and door configuration.

1. Full-size moulding section detail and door configuration.
2. Glazing material and louver thickness, when applicable.

C. Certificates: Certificates of compliance with fabrication and test requirements signed by authorized representative of door manufacturing company.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver doors to site after plaster and cement are dry and building has reached average prevailing relative humidity of locality.

B. Deliver doors in manufacturer's original unopened protective material or container, clearly marked with manufacturer's name, brand name, size, thickness, and identifying symbol on covering.

C. Seal all four edges of doors when delivered to project site.

D. Stack flat on 2×4 lumber, laid 12 inches from ends and across center.

E. Under bottom door and over top of stack, provide plywood or corrugated cardboard to protect door surface.

F. Store doors in area where there will be no great variations in heat, dryness and humidity.

G. Do not drag doors across one another.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Specific products or materials manufactured by any of the following listed manufacturers are "acceptable" (not approved) only if the specific product or material can evidence exact compliance with the Contract Documents.

1. Algoma Hardwoods, Inc., Algoma, Wisconsin
2. Eggers, Neenah, Wisconsin
3. Graham Manufacturing Corporation, Marshfield, Wisconsin.
4. Weywehauser Company, Marshfield, Wisconsin.

B. Provide the product of one manufacturer.

2.02 MATERIALS:

A. Flush Wood Doors:

1. Door standards: NWMAI-S: - 69
2. To match existing entry doors into Lab 211 "A-grade" - for stain and polyurethane finish.
3. Finish shall be provided by Contractor at the site.
4. Provide quarter cut, "Pleasing Match".
5. Refer to door schedule.

6. Field verify all dimensions and field conditions.
7. All doors shall be manufactured to suit existing and new metal frame assembly conditions.
8. Core: Solid wood core glued block or framed-block glued core.
9. UL Approved "C" and "B" Labeled Fire rated doors: Edge bands of KILN-DRIED Hardwood treated with fire retardant treatment.

2.03 FABRICATION:

A. Moisture Content: 12% maximum at time of fabrication for all wood material.

B. Solid Core:

1. Glued Block Core: Core blocks 2-1/2 inches maximum width, bonded together; end joints staggered in adjacent rows.
2. Bond face panels of core.
3. Stile and rail edge bands, 1/2 inch minimum width, bonded to core.
4. Stile and rail frame, 1-1/8 inch, minimum width; not glued to core.

C. Face Panels:

1. Side match veneers for grain and color at meeting stiles for doors hung in pairs.

D. Light Openings: Mouldings and glass stops of steel - Painted.

E. Clearances:

1. Allow maximum of 1/8 inch at jamb and head for job fit doors.
2. Allow maximum of 3/16 inch at jamb and head for pre-fit doors.
3. Allow maximum of 3/16 inch over threshold or saddle.
4. Allow maximum of 1/2 inch over decorative floor coverings, unless otherwise noted on drawings or in the Project Manual.
5. Maximum 3/8 inch between door bottoms and decorated floor for pairs of doors unless otherwise noted on drawings or in the Project Manual.
6. Maximum Warp: 1/8 inch.

F. Finishing:

1. Finish shall be completed "on-site".

2. Finish doors, faces and side edges on site. Finish shall be as noted herein or on the drawings and shall be approved by the Architect.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Verify that doors are of type required for frame and are installed as required for proper installation of doors.

B. Fire-rated doors shall be installed in corresponding fire rated frames.

3.02 INSTALLATION:

A. Follow door manufacturer's written instruction for all installation work.

B. Do not install doors in frames which would hinder the operation of the doors.

C. Fire-Rated Doors:

1. Install in accordance with National Fire Protection Association (NFPA) recommendations.

3.03 ADJUST AND CLEAN:

A. Replace or re-hang doors which are hinge-bound and do not swing or operate freely.

B. Replace doors damaged during installation.

END OF SECTION

SECTION 08 71 00 FINISH HARDWARE

PART 1 - GENERAL

1.01 DESCRIPTION:

A. The work covered by these specifications shall include the furnishing and delivery to the job site of finish hardware, complete and in strict accordance with these specifications and the applicable drawings, and ready for complete and proper installation by the Contractor.

B. It shall be the sole responsibility of the Contractor to provide all necessary items of hardware required for a complete and proper installation. Any hardware item required and not definitely specified herein, or not specifically mentioned but necessary for complete installation of the work, shall conform in type and quality to the items specified and shall be provided by this Contractor as part of his Contract at no additional cost to the Owner.

C. Provide all electrical work required for a complete and proper job. Carefully coordinate the work of this section with the work of other sections of the work indicated on the drawings.

D. Related Work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and sections in Division 1 of these Specifications.

1.02 SUBMITTALS:

A. Samples: The Contractor shall submit to the Architect and Owner for approval.

B. Schedule: The Contractor shall submit to the Architect for review, (5) copies of a complete and properly itemized schedule of all finish hardware be furnished under this Contract with the calling of each item clearly referred to as per manufacturer's code letters and numbers.

C. Templates: The complete template information necessary for the fabrication of doors and frames etc.

D. Manufacturer's Recommendations: Prior to installation, deliver to all installing personnel, complete recommendations from the manufacturer regarding installation methods.

E. Key Schedule: After a keying meeting between representatives of the Owner, Architect, hardware supplier, and, if requested, the representative for the lock manufacturer, provide a keying schedule, listing the levels of keying, as well as an explanation of the key system's function, the key symbols used, and the door numbers controlled. Utilize ANSI

A156.28 "Recommended Practices for Keying Systems" as a guideline for nomenclature, definitions, and approach for selecting the optimal keying system.

F. Operations and Maintenance Data: Provide in accordance with Division 1 and include the following:

1. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
2. Catalog pages for each product.
3. Name, address, and phone number of local representative for each manufacturer.
4. Parts list for each product.
5. Copy of final approved hardware schedule, edited to reflect "As installed."
6. Copy of final keying schedule.
7. As installed "Wiring Diagrams" for each opening connected to power, both low voltage and 110 volts.
8. One (1) complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
9. Copy of warranties including appropriate reference numbers for manufacturers to identify the project.

G. Certificates of Compliance: Upon request of Architect or Authority Having Jurisdiction certificates of compliance for fire-rated hardware and installation instructions shall be made available.

1.03 GUARANTEE/QUALITY ASSURANCE:

A. All material furnished under this Contract shall be guaranteed free from defects by manufacturer for a period of one (1) year from the date of Final Acceptance of the building. Any defective material shall be removed and replaced at no expense to the Owner.

B. Provide manufacturer's warrantees as specified in Division 1 and as follows:

1. Closers: 30 years, except electronic closers, 2 years.
2. ND Locksets: 10 years, except electrified locksets, 1 year.

C. Qualifications of Supplier: The finish hardware supplier shall have in his employ an AHC member of the American Society of Hardware Consultants who shall be made available for consultation at no additional cost to the Owner and Architect during the course of construction.

D. Review by AHC: (or manufacturer's hardware consultant)

1. The AHC shall be present at completion of the work, shall check the installation of all finish hardware, shall make all minor adjustments required and supervise all hardware replacements required. He shall report to the Architect on completeness of the installation.
2. The Manufacturer's Hardware Consultant shall review and approve all submittals prior to Contractor ordering product.

E. Contractor and Manufacturer's Hardware Consultant shall verify that specified automatic closer/holder assembly is properly suited for each particular application. Do so prior to submitting bid. Submit shop drawings and shop drawing hardware schedule including type of closer/holder recommended for installation at each door/frame assembly location.

1.04 PACKING AND MARKING:

A. All hardware items required shall be individually packed, complete with all screws, bolts, washers and all other necessary accessories for proper installation. Each individual container shall be marked with item numbers corresponding to numbers on the approved schedule identifying contents and location of the item in the finished work. After delivery, this Contractor shall lay out all the hardware in a designated secure area and then check same with the General Contractor's representative.

B. Delivery:

1. Deliver all finish hardware to the installers in a timely manner to ensure orderly progress of the total work.

1.05 WORK INCLUDED:

A. All labor, materials, templates, equipment and services required to furnish and install the finish hardware complete as required by the drawings, as herein specified.

B. All electrical related work, refer to electrical drawings and specifications.

1.06 WORK NOT INCLUDED:

A. Hardware for the following items if and when applicable in other sections of the specifications:

1. Installation by other sections unless otherwise noted.
2. Sash Hardware
3. Toilet Partition Hardware
4. Toilet Accessories
5. Handrail Brackets
6. Casework Hardware as provided by Casework Supplier
7. Aluminum Door Hardware - except for cylinder

1.07 U.L. REQUIREMENTS:

A. Provide hardware which complies with NFPA Standards #80 for Fire Rated openings and #101 for Life Safety. Only hardware which has been tested and listed by U.L. for the type and sizes of doors required and which complies with the requirements of the door and frame label is acceptable.

PART 2 - PRODUCTS

2.01 FASTENERS:

A. Furnish all finish hardware with all necessary screws, bolts and other fasteners of suitable size and type to anchor the hardware in position for long life under hard use.

B. Furnish fastenings where necessary with expansion shields, toggle bolts, sex bolts and other anchors approved by the A/E, according to the material to which the hardware is to be applied and the recommendations of the hardware manufacturer.

C. Design - all fastening shall harmonize with the hardware as to material and finish.

2.02 KEYING:

A. Provide cores and cylinders for the Owner's existing key system conforming to the following requirements & per the Owner's directives:

1. Provide removable core cylinders at all keyed devices, locksets, cylinder dogging and exit device trim. Ensure classroom function doors have inside core. Provide construction cores with construction master keying for use during construction and in the event that final keying is not available at the time of occupancy. The hardware supplier, accompanied by the Owner or Owner's security agent, shall install permanent keyed cores upon completion of the project. The temporary construction cores are to be returned to the hardware supplier.
2. Provide permanent cores and cylinders keyed by the manufacturer or authorized distributor into the existing key system as directed by the Owner. Provide Owner with a copy of the bitting list, return receipt requested.

   Coordinate with CCRI's Security & IT personnel with regards to keying, wireless security system coordination, and to conform to all CCRI standards for access control & security protocols.

3. The hardware supplier, accompanied by a qualified factory representative for the manufacturer of the cores and cylinders, shall meet with the Owner and Architect to review keying requirements and lock function prior to ordering finish hardware. Submit a keying schedule to the Architect for approval within two weeks of Purchase Order Issuance.
4. Provide construction core keys as follows:

   a) Five Master Keys
   b) Four keys per core

5. Provide permanent core keys as follows:

   a) Ten Master Keys
   b) Four keys per core

6. Visual key control:

   a) Keys shall be stamped with their respective key set number and stamped "DO NOT DUPLICATE."
   b) All keys shall be stamped with their respective key set letters.
   c) Do not stamp any keys with the factory key change number.
   d) Do not stamp any cores with key set on the face (front) of the core. Stamp on side of the cores so as to be not visible when core is in cylinder.

7. Deliver all keys and/or key blanks from the factory or authorized distributer directly to the Owner in sealed containers, return receipt requested. Failure to comply with these requirements may be cause to require replacement of all or any part of the keying system that was compromised at no additional cost to the Owner.

8. Approved products: Medeco X4 SFIC or as approved by CCRI.

   a) Provide "Key Log" to Owner upon completion of project.
   b) Provide U.L. approved, C-labeled, lockable metal key box cabinet of size and configuration to accommodate one hook per key, plus forty (40) additional key hooks. Key box shall be surface mounted where directed by the Owner. Key box cabinet shall be factory finished.

2.03 ACCEPTABLE MANUFACTURERS:

A. Catalog numbers used in the Hardware Schedule are taken from the indicated manufacturers and all finish hardware shall be the hardware specifically described unless otherwise directed by the Owner. Contractor shall consult Owner prior to ordering all hardware listed below.

B. Submit to Architect, written statement that Owner has reviewed and accepts specified hardware. Submit all revisions to Architect for review prior to ordering.

C. Field verify all dimensions prior to ordering – Contractor shall be responsible for dimensional correctness.

Hardware Doors:

ITEMS	MANUFACTURER	MODEL #
Butts (Hinges)	Stanley FBB Series Bommer 5000 series Ives 5BB Series	Ball Bearing, Heavy Duty Full Mortise Hinges (Standard and Full Swing Clear)
Lever handle, lockset and latchset	Schlage	Classroom Lock: AD-400-CY-70-MTK-RHO-626
Locks & Cylinders	Medeco	X4, SFIC, or as approved by CCRI

Wall Bumpers and floor stops	Hager	230 W and 240 F door stop, Satin Chromium Plated- Contractor Note -Provide wood bracing and blocking within wall assembly, typical all wall stops.
Door Closers	Sargent	350/351 Series
Kick plates	Rockwood	Stainless steel – 18" high x width ofdDoor, minus 2" each side, unless otherwise directed on the drawings.
Silencers	Rockwood or H.B. Ives	

2.04 FINISH:

A. Hardware generally shall be bronze metal with dull chrome plated finish, US26D, unless otherwise noted. If not noted elsewhere, the following shall apply.

1. Exterior Butts - Solid Bronze - Dull Chrome Plate
2. Interior Butts - Steel, Dull Chrome Plate
3. Door Closers - Sprayed Aluminum
4. Push Plates & Kick Plates - Stainless Steel US32D
5. Door pulls - Stainless Steel US 32D
6. Door Push Plates - Stainless Steel US32D
7. Aluminum Door Cylinders - Chrome US26D.

2.05 LOCKSET & LATCHSET DESIGN:

A. Refer to pertinent sections herein.

2.06 OTHER MATERIALS:

A. All other materials not specifically described but required for a complete and proper finish hardware installation shall be as selected by the Contractor subject to the approval of the A/E.

B. Access Control Systems

1. Electrified Strikes – Provide electrified strikes to function with DSX Access Control Systems. Contractor is to coordinate and provide any and all hardware required for complete hardware sets that are fully compatible with the Access Control System.

C. Cylindrical Locks - Grade 1

2. Provide cylindrical locks conforming to ANSI A156.2 Series 4000, Grade 1. Cylinders: Refer to 2.04 KEYING.
3. Provide locks with a standard 2-3/4 inches backset, unless noted otherwise, with a 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
4. Provide locksets with a separate anti-rotation throughbolts, and shall have no exposed screws. Levers shall operate independently, and shall have two external return spring cassettes mounted under roses to prevent lever sag.
5. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
6. Provide electrified strikes at all doors controlled by the DSX Access Control System. Refer to drawings for doors and refer to Specification Section 26 00 00 for DSX Access Control system information.
7. Provide electrical options as scheduled.

PART 3 - EXECUTION

3.01 DELIVERIES:

A. Stockpile all items sufficiently in advance to ensure their availability and make all necessary deliveries in a timely manner to ensure orderly progress of the total work.

3.02 EXAMINATION

A. Prior to installation of any hardware, examine all doors, frames, walls and related items for conditions that would prevent proper installation of finish hardware. Correct all defects prior to proceeding with installation.

3.03 PROTECTION:

A. Finish hardware shall not be installed until all operations or work causing dampness has been completed and thoroughly dried. Knobs, handles and projecting parts shall be wrapped in cloth or soft paper to protect the finish until the project is accepted by the Owner.

3.04 INSPECTION OF INSTALLATION:

A. Upon completion of the installation and as a condition of its acceptance, deliver to the A/E, a report signed by the AHC stating that his/her inspection was made, that all adjustments recommended by him have been completed and that all finish hardware furnished under this section has been installed and is in optimum working condition.

3.05 FINISH HARDWARE SCHEDULE:

A. The Contractor shall be responsible for complete examination of the drawings and shall furnish a hardware schedule required for a complete and proper installation.

3.06 ADJUSTING, CLEANING, AND DEMONSTRATING

A. Adjust and check each operating item of hardware and each door, to insure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly.

B. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make a final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

C. Clean adjacent surfaces soiled by hardware installation.

D. Instruct Owner's personnel in the proper adjustment, lubrication, and maintenance of door hardware and hardware finishes.

3.07 FIELD QUALITY CONTROL

A. Prior to Substantial Completion, the installer, accompanied by representatives of the manufacturers of locks, exit devices, closer, and any electrified hardware, shall perform the following work:

1. Examine and re-adjust each item of door hardware as necessary to restore function of doors and hardware to comply with specified requirements.
2. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures.
3. Replace hardware items that have deteriorated or failed due to faulty design, materials, or installation of hardware units.
4. Prepare a written report of current and predictable problems of substantial nature in the performance of the hardware.
5. At completion of project, a qualified factory representative for the manufacturers of locksets, closer, exit devices, and access control products shall arrange and hold a training session to instruct the Owner's personnel on the proper maintenance, adjustment, and/or operation of their respective products. After training a letter of compliance, indicating when the training was held and who was in attendance, shall be sent to the Architect.

3.08 PROTECTION

A. Provide for the proper protection of complete items of hardware until the Owner accepts the project as complete. Damaged or disfigured hardware shall be replaced or repaired by the responsible party.

3.09 HARDWARE SCHEDULE

A. Provide hardware for each door to comply with requirements of Section "Finish Hardware," and as indicated on the drawings.

B. Provide Hardware Schedule including complete items of finish hardware necessary to complete the work to the Owner & Architect for approval in Shop Drawing form.

C. Locksets, exit devices, and other hardware items are referenced in the Hardware Sets for series, type, and function. Refer to the preamble for special features, options, cylinders/keying, and other requirements.

D. Coordinate with CCRI's Security & IT personnel with regards to keying, wireless security system coordination, and to conform to all CCRI standards for access control & security protocols.

E. Existing doors with AD-400 hardware to be integrated into final configuration of system if possible, requiring no new hardware if fully operable.

END OF SECTION

SECTION 08 80 00 GLASS & GLAZING

PART 1 – GENERAL

1.01 DESCRIPTION:

A. This section shall consist of all labor, equipment, and materials necessary to complete all glass and glazing as indicated on the drawings, herein indicated, or both.

B. Work installed but furnished by others:

1. Metal stops for hollow metal frames, metal doors and frames, Section 081000.

C. Related Work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.02 SUBMITTALS:

A. Full-sized details of fastenings, setting blocks and spacers as well as complete schedule of location of each type of glass shall be submitted in accordance with the Section 08100, Supplementary/Special Conditions, prior to ordering materials.

1.03 PRODUCT HANDLING:

A. All materials shall be delivered, stored, handled and installed so as not to be damaged.

B. Each light of glass shall bear manufacturer's label indicating name of manufacturer and quality of glass, including weight or thickness where applicable. Absence of label may constitute cause for rejection, except that cut from local stock. Vendor shall furnish affidavit attesting to compliance with specification and stating manufacturer's name, quality, thickness and type of glass furnished.

C. Glass shall be stored in a clean, dry area to prevent staining.

D. Glass shall be delivered in the manufacturer's original unopened containers, bearing the manufacturer's label.

E. Glass shall be carefully handled so as to prevent scratching and chipping. Do not remove paper covering until time recommended by manufacturer.

1.04 ENVIRONMENTAL CONDITIONS:

A. Glazing shall not be completed when the ambient temperature is below 40 degrees F., except that the Contractor may erect suitable enclosures with adequate heating of enclosed space to raise surface temperatures of frames and glass above 40 degrees F.

1.05 QUALITY ASSURANCE:

A. Conform to Fed. Specs. DO-G-451 and DD-G-451D(1)

B. Manufacturer's label showing strength, grade, thickness, type and quality will be required on each piece of glass. Labels must remain on glass until it has been set and inspected.

C. Bidders are directed to visit site and become familiar with actual sizes and existing conditions prior to submitting bid. Notify Architect prior to submitting bid, of any condition different from that specified.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Manufacturer:

1. Libby-Owens-Ford Glass Company.

2. PPG Architectural Glass.

3. Viracon.

4. Old Castle Glass.

2.02 MATERIALS:

A. Tempered Glass: 1/4 inch polished plate float safety glass. Use in doors with vision panels, interior sidelites transoms and observation windows and as required by code.

B. Wire Glass: 1/4 inch wire glass with square grid, size as noted on the drawings, if applicable.

C. Laminated Safety Glass: 1/4 inch impact safety-rated meeting ANSI 297.1 and CPSC 16CFR1201 (cat.1 and/or 1), if applicable. Glass shall be multi-laminate; sensitive polymer gel units will not be accepted.

2.03 OTHER RELATED MATERIALS:

A. Glazing Compound Manufacturers:

1. Pecora
2. Dicks-Armstrong Pontius
3. Tremco Manufacturing Company
4. Nippon Electric Glass Company, Ltd.

B. Glazing tape shall be extruded butyl, Tremco 440 or approved equal, for glass.

C. Setting Blocks and Spacers: Resilient types and materials as recommended by manufacturer of glass or glazing materials.

D. Glazing Film – Interior Opaque "black" glazing film by 3M, or approved equal.

1. General: Glass and plastic finishes field-applied application to glass or plastic material as visual opaque.
2. Film: Polyester
3. Decorative Pattern: Opaque Black
4. Adhesive: Acrylic, Pressure Sensitive, Permanent
5. Liner: Silicone-coated Polyester
6. Thickness (Average): 3.2 mils (80 microns)
7. Fire Performance: Surface burning characteristics when tested in accordance with ASTM E84: Class A

   a) Flame Spread: 25 maximum.
   b) Smoke Developed: 450 maximum.

8. Application Characteristics: Privacy Glazing Film applied to 3mm thick clear glass (ASTM E 903, ASTM E 308):

   a) Ultraviolet Transmittance: 0.1 percent.
   b) Visible Light Transmittance: 0.4 percent.
   c) Visible Light Reflectance - Interior: 5 percent.
   d) Solar Heat Transmittance: 1 percent.
   e) Solar Heat Reflectance: 5 percent.
   f) Shading Coefficient at 90 Degrees (Normal Incidence): 0.39.

E. Glazing Film – EMF Shielding glazing film.

1. Acceptable manufacturers of EMF Shielding Film (for Rm. #2066):
   a. ScotchTint by 3M
   b. RDF72 by EMR Shielding Solutions
   c. Approved Equal.

2. Install at all glazing in Room #2066 including at door vision lite.

3. Install per manufacturer's recommendations & directives.

2.04 INSPECTION SURFACES:

A. All surfaces of openings to receive glass shall be examined for defects insofar as they affect glass and glazing work. Glazing work shall not be started until such defects have been corrected.

2.05 PREPARATION FOR GLAZING:

A. All surfaces of openings shall be properly primed where necessary and protective coatings removed from surfaces to be glazed.

B. Protective coatings, film, etc. shall be removed from aluminum surfaces to be glazed. Use a solvent which will not etch or mar the finish.

C. All surfaces to be sealed shall be dry, free from oil, dust, etc. and wiped clean before applying sealants.

D. Glass shall be free from dust, oil, etc. and wiped clean immediately before installation.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Glazing in Metal Channel:

1. Glass bedded, backs puttied, secured in place and, except where glazing beads are required, shall be face puttied. Secure glass with non-ferrous glazier's points or clips or beads as required.
2. Provide neoprene setting blocks as required.
3. Glaze all operating sash in closed position.
4. All glass shall be cut to fill sizes required for the openings from measurements taken at the project site. All cut edges shall be smooth and straight.
5. Stops and glazing beads, where provided, shall be removed before glazing and carefully reset after glazing.
6. Labels shall not be removed until final approval is obtained.

B. Install glass with waviness parallel to floors.

C. All glass and glazing shall be installed according to manufacturer's printed instructions, in strict compliance with the recommended practice as stated in "The Flat Glass Jobbers Association Glazing Manual", latest edition.

3.02 PROTECTION AFTER INSTALLATION:

A. After installation, precaution shall be taken against breakage or other damage to glass.

B. Glazed openings shall be identified with colorful flags or festoons attached to the glass holding members at the head of jambs.

C. Glass shall be protected from plaster, sandblasting and welding spatter.

D. Replace any damaged or broken glass at no expense to the Owner.

3.03 CLEAN-UP:

A. All glass, wood and metal to be cleaned of excess glazing compound.

B. Wash glass completely after installation.

C. Glass broken after proper installation and cleaning shall be the responsibility of the General Contractor at no additional cost to the Owner.

D. Glass broken because of faulty setting shall be replaced by the Contractor at no additional cost to the Owner.

E. Remove all broken glass, glazing compound, etc., from site after completion of work.

3.04 WARRANTY:

A. Provide manufacturer's standard warranty, five (5) years, for security glass against defects such as edge separation or obstruction of vision.

END OF SECTION

SECTION 09 26 00 GYPSUM WALLBOARD SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Work included: Provide gypsum drywall, metal framing, sound attenuating batt insulation and accessories where shown on the drawings, as specified herein, and as needed for a complete and proper installation.

B. Related Work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.02 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. Imperfections noticeable from 4'-0" away will not be accepted.

1.03 SUBMITTALS:

A. Comply with pertinent provisions of Section 013000.

B. Product Data:

1. Materials list, of items proposed to be provided under this section.
2. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
3. Manufacturer's recommended installation procedures, which, when approved by the A/E, will become the basis for accepting or rejecting actual installation procedures used on the work.

PART 2 - PRODUCTS:

2.01 GYPSUM WALLBOARD:

A. Manufacturers of Gypsum Board: Georgia-Pacific Corp., National Gypsum Co., United States Gypsum Co., or equal.

1. Provide 5/8" gypsum wallboard, refer to drawings, complying with Fed. Spec. SS-L-3OD, in 48" widths and in such lengths as will result in a minimum of joints.
2. Fire-retardant wallboard: Provide Type III, Grade X, Class I.

3. Cement Backer Board: 5/8" Fiberock, as manufactured by U.S.G. or approved equal.

2.02 METAL TRIM:

A. Form from zinc-coated steel not lighter than 26 gauge, complying with Fed. Spec. QQ-S-775, Type I, Class D or E.

B. Corner Beads: Provide angle shapes with wings not less than 7/8" wide and perforated for nailing and joint treatment, or with combination metal and paper wings bonded together, not less than 1-1/2" wide and suitable for joint treatment.

2.03 JOINTING SYSTEM:

A. Provide a jointing system, including reinforcing tape and compound, designed as a system to be used together and as recommended for this use by the manufacturer of the gypsum wallboard approved for use on this work.

B. Jointing compound may be used for finishing if so recommended by its manufacturer.

2.04 FASTENING DEVICES:

A. For fastening gypsum wallboard in place on wood, use 1-1/4", Type W, bugle-head screws, complying with ASTM C514 and of the length required by manufacturer.

B. For fastening to steel studs use flat head screws, 1" long with self-tapping threads.

2.05 METAL STUDS:

A. Metal Studs:

1. At interior metal stud partitions and ceilings, unless otherwise shown on the drawings, provide standard punched steel studs of 20-gauge, hot-dip galvanized; size as shown on the drawings.
2. Provide 14, 16 and18 gauge metal-stud framing in locations as determined by the stud manufacturer for that specific use & loads if required.
3. Use only one type throughout the work, unless otherwise shown on the drawings or specifically approved in advance by the A/E.
4. All studs shall extend to underside of floor structure above unless otherwise directed. Refer to pertinent notes, sections, and details on the drawings.

B. Metal header assemblies:

1. Provide punched steel studs of 14, 16 and 18 gauge, hot-dip galvanized; size as required for specific opening and/or as shown on the drawings.

C. Metal Studs to each end of metal header assembly:

1. Provide punched steel studs of 14, 16 and 18 gauge, hot-dip galvanized; size as required for specific opening and/or as shown on the drawings.

D. Metal Furring:

1. Provide standard steel furring channels of 22 gauge, hot-dip galvanized; size as shown on the drawings.

E. Metal Runner:

1. Width of studs by 1" high × standard length.
2. Required at head and floor and as header over doors.

F. Reinforcing:

1. Width of studs as required for surface mounted tackboards, bulletin boards, liquid writing surfaces, toilet room accessories such as grab bars, shower rods, etc.

G. Accessories: Provide all accessories including, but not necessarily limited to, tracks, clips, anchors, fastening devices, sound attenuation pencil rods, and resilient clips, and other accessories required for a complete and proper installation, and as recommended by the manufacturer of the steel studs used.

2.06 SOUND ATTENUATING BATT INSULATION

A. MANUFACTURERS:

1. Johns Manville
2. Knauf
3. Owens Corning

B. Sound Attenuation blankets: (between all studs of interior wall framing partitions and elsewhere as indicated on the drawings)

1. Thermafiber Sound Attenuation blankets: thickness as per stud size, 16" wide, 48" long.

PART 3- EXECUTION

3.01 SURFACE CONDITIONS:

A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to a timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION OF GYPSUM BOARD:

A. Install gypsum wallboard in accordance with the drawings.

B. At internal and external corners, conceal the cut edges of the boards by the overlapping covered edges of the abutting boards.

C. Stagger the boards so that corners of any four boards will not meet at a common point except in vertical corners.

D. Ceilings / Soffits:

1. Install the gypsum wallboard to ceilings with the long dimension of the wallboard at right of angles to the supporting members.
2. Wallboard may be installed with the long dimension parallel to supporting members that are spaced 16" on centers when attachment members are provided at end joints.

E. Walls:

1. Install the gypsum wallboard to studs at right angles to the furring or framing members.
2. Make and joints, where required, over framing or furring members.

F. Attaching:

1. Drive the specified screws with clutch-controlled power screw-drivers, spacing the screws 12" on centers at ceiling and 16" on centers at ceiling at walls.
2. Attach double layers in accordance with the drawings, pertinent codes and the manufacturer's recommendations as approved by the A/E.

3.03 JOINT TREATMENT:

A. General:

1. Inspect areas to be joint treated, verifying that the gypsum wallboard fits snugly against supporting framework.
2. In areas where joint treatment and compound finishing will be performed, maintain a temperature of not less than 55 degrees for 24 hours prior to commencing the treatment, and until joint and finishing compounds are dried.
3. Apply the joint treatment and finishing compound by machine or hand tool.
4. Provide a minimum drying time of 24 hours between coats, with additional drying time in poorly ventilated areas.

B. Embedding Compounds:

1. Apply to gypsum wallboard joints and fastener heads in a thin, uniform layer.
2. Spread the compound not less than 3" wide at joints, center the reinforcing tape in the joint, and embed the tape in the compound. Then spread a thin layer of compound over the tape.

3. After this treatment has dried, apply a second coat of embedding compound to joints and fastener heads, spreading in a thin uniform coat to not less than 6" wide at joints, and feather edge.
4. Sandpaper between coats as required.
5. When thoroughly dry, sandpaper to eliminate ridges and high points.

C. Finishing Compounds:

1. After embedding compound is thoroughly dry and has been completely sanded, apply a coat of finishing compound to joints and fastener heads.
2. Feather the finishing compound to not less than 12" wide.
3. When thoroughly dry, sandpaper to obtain a uniformly smooth surface, taking care to not scuff the paper surface of the wallboard.

3.04 CORNER TREATMENT:

A. Internal Corners: Treat as specified for joints, except fold the reinforcing tape lengthwise through the middle and fit neatly into the corner.

B. External Corners:

1. Install corner bead, fitting neatly over the corner and securing with the same type fasteners used for installing the wallboard.
2. Space the fasteners approximately 6" on centers, and drive through the wallboard into the framing or furring member.
3. After the corner bead has been secured into position, treat the corner with joint compound and reinforcing tape as specified for joints, feathering the joint compound out from 8" to 10" on each side of the corner.

3.05 CLEANING UP:

A. In addition to other requirements for cleaning, use necessary care to prevent scattering gypsum wallboard scraps and dust, and to prevent tracking gypsum and joint finishing compound onto floor surfaces.

B. At completion of each segment of installation in a room or space, promptly pick up and remove from the working area, all scrap, debris, and surplus material of this section.

END OF SECTION

096516 RESILIENT FLOORING – VINYL SHEET FLOORING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Flooring and accessories as shown on the drawings and schedules and as indicated by the requirements of this section.

B. Related Documents

1. Drawings and General Provisions of the Contract (including General and Supplementary Conditions and Division 1 sections) apply to the work of this section.

C. Related Sections:

1. Division 6 Wood and Plastics; not the work of this section
2. Division 7 Thermal and Moisture Protection; not the work of this section

1.02 REFERENCES

A. ASTM International:

1. ASTM E 648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
2. ASTM E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
3. ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
4. ASTM F 1482, Standard Guide to Wood Underlayment Products Available for Use Under Resilient Flooring
5. ASTM F 1861 Standard Specification for Resilient Wall Base
6. ASTM F 1869 Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
7. ASTM F 1913 Standard Specification for Vinyl Sheet Floor Covering Without Backing
8. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

B. National Fire Protection Association (NFPA):

1. NFPA 253 Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
2. NFPA 258 Standard Test Method for Measuring the Smoke Generated by Solid Materials

C. Standards Council of Canada

1. CAN/ULC-S102.2 Standard Test Method for Surface Burning Characteristics of Flooring, Floor Covering and Miscellaneous Materials and Assemblies

1.03 SYSTEM DESCRIPTION

A. Performance Requirements: Provide flooring which has been manufactured, fabricated and installed to performance criteria certified by manufacturer without defects, damage, or failure.

B. Administrative Requirements

1. Pre-installation Meeting: Conduct an on-site pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements. Comply with Division 1 Project Management and Coordination (Project Meetings) Section.
2. Pre-installation Testing: Conduct pre-installation testing as follows: [Specify testing (i.e. moisture tests, bond test, pH test, etc)

C. Test Installations/ Mock-ups: Install at the project site a job mock-up using acceptable products and manufacturer approved installation methods, including concrete substrate testing. Obtain Owner's and Consultant's acceptance of finish color, texture and pattern, and workmanship standards.

1. Mock-Up Size: 3ft x 3ft. Mock up is to include a seam of two sections of equal size.
2. Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
3. Incorporation: Mock-up may be incorporated into the final construction with Owner's approval.

D. Sequencing and Scheduling

1. Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring.
2. Do not install flooring over concrete slabs until they are sufficiently dry to achieve a bond with the adhesive, in accordance with the manufacturer's recommended bond, moisture tests and pH test.

1.04 SUBMITTALS

A. Submit shop drawings, seaming plan, coving details, and manufacturer's technical data, installation and maintenance instructions for flooring and accessories.

B. Submit the manufacturer's standard samples showing the required colors for flooring, welding rods, and applicable accessories.

C. Submit Safety Data Sheets (SDS) available for flooring products, adhesives, weld rod, patching/leveling compounds, floor finishes (polishes) and cleaning agents.

D. If required, submit the manufacturer's certification that the flooring has been tested by an independent laboratory and complies with the required fire tests.

E. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products, and precautions against cleaning materials and methods detrimental to finishes and performance.
2. Warranty: Warranty documents specified herein

1.05 QUALITY ASSURANCE

A. Single-Source Responsibility: provide types of flooring and accessories supplied by one manufacturer, including leveling and patching compounds, and adhesives.

B. Select an installer who is competent in the installation of homogenous resilient sheet flooring using heat-welded seams.

1. Engage installers certified as Armstrong Commercial Flooring Certified Installers
2. Confirm installer's certification by requesting their credentials

C. Fire Performance Characteristics: Provide homogenous resilient vinyl sheet flooring with the following fire performance characteristics as determined by testing material in accordance with ASTM test methods indicated below by a certified testing laboratory or other testing agency acceptable to authorities having jurisdiction:

1. ASTM E 648 Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I
2. ASTM E 662 (Smoke Generation) Maximum Specific Optical Density of 450 or less
3. CAN/ULC-S102.2 – Flame Spread Rating and Smoke Developed – Results as tested

1.06 DELIVERY, STORAGE, AND HANDLING

A. Comply with Division 1 Product Requirements Sections

B. Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.

C. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.

D. Store materials in a clean, dry, enclosed space off the ground, protected from harmful weather conditions and at temperature and humidity conditions recommended by the manufacturer. Protect adhesives from freezing. Store flooring, adhesives and accessories

in the spaces where they will be installed for at least 48 hours before beginning installation.

1.07 PROJECT CONDITIONS

A. Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65ºF (18ºC) and a maximum temperature of 85ºF (29ºC) for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature of 55ºF (13ºC) in areas where work is completed. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances. Refer to the Manufacturer's Installation Instructions for a complete guide on project conditions.

1.08 LIMITED WARRANTY

A. Resilient Flooring: Submit a written warranty executed by the manufacturer, agreeing to repair or replace resilient flooring that fails within the warranty period.

B. Limited Warranty Period: 5 years

C. The Limited Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

D. For the Limited Warranty to be valid, this product is required to be installed using the appropriate Manufacturer's Installation Instructions.

1.09 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials from same production run as products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Quantity: Furnish quantity of flooring units equal to 10% of amount installed.
2. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra material.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. To establish a standard of quality, design and function desired, Drawings and specifications have been based on Tarkett iQ Acoustic Vinyl flooring homogenous sheet vinyl flooring. At the Contractor's option, homogenous sheet vinyl flooring wall base, adhesives and accessories complying with the material and construction requirements specified herein may be provided from the following listed manufacturers, or approved equal

1. Mannington Mills, Inc, 75 Mannington Mills Rd, Salem, NJ 08079
   https://www.manningtoncommercial.com/
2. Tarkett Inc, 30000 Aurora Rd, Solon, OH 44139
   https://commercial.tarkett.com/en_US/node/resilient-500
3. Or Approved Equal

2.02 RESILIENT SHEET FLOORING MATERIALS

A. Homogeneous Sheet Vinyl Flooring:

1. Description: An unbacked, nonlayered, homogeneous sheet vinyl flooring. Protected by a UV-cured polyurethane finish, the colors and pattern detail are dispersed uniformly throughout the thickness of the product. Color pigments are insoluble in water and resistant to cleaning agents and light.
2. Homogeneous sheet flooring shall conform to the requirements of ASTM F1913 Standard Specification for Vinyl Sheet Floor Covering Without Backing
3. Pattern and Color: in color selected from the manufacturers available color range
4. Width: 6 ft. (1.83 m).
5. Length: up to 82 lineal feet (25 meters)
6. Thickness: 0.080 in. (2.0 mm)

B. Vinyl Weld Rod:

1. Provide matching vinyl weld rod as produced by the same Manufacturer of the homogeneous sheet vinyl flooring, and intended for heat welding of seams. Color shall be compatible with field color of flooring. Color is to be selected from the manufacturers available color range.

C. Seam Adhesive:

1. Provide Seam Adhesive at seams as recommended by the resilient flooring manufacturer.

2.03 PRODUCT SUBSTITUTION

A. No substitutions allowed.

2.04 WALL BASE MATERIALS

A. Provide 1/8 in. (3.2 mm)] thick, 4 in. (10.16 cm) high Wall Base with a matte finish, conforming to ASTM F 1861, Type TP - Rubber, Thermoplastic, Group 1 - Solid, Style B – Cove

2.05 ADHESIVES

A. Provide Vinyl Sheet Flooring Adhesive Premium Commercial Adhesive for field areas and Wall Base Adhesive at the wall base as recommended by the flooring manufacturer.

2.06 ACCESSORIES

A. For patching, smoothing, and leveling concrete subfloors provide Fast-Setting Cement-Based Patch and Underlayment.

B. For sealing joints between the top of wall base and irregular wall surfaces such as masonry, provide plastic filler applied according to the manufacturer's recommendations.

C. Provide transition/reducing strips tapered to meet abutting materials.

D. Provide threshold of thickness and width as shown on the drawings.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including technical bulletins, product catalog, installation instructions, and product carton instructions for installation and maintenance procedures as needed.

3.02 EXAMINATION

A. Site Verification of Conditions: Verify existing substrate conditions are acceptable for product installation in accordance with manufacturer's instructions (i.e. moisture tests, bond test, pH test, etc.).

B. Visually inspect flooring materials, adhesives and accessories prior to installation. Flooring material with visual defects shall not be installed and shall not be considered as a legitimate claim.

C. Examine subfloors prior to installation to determine that surfaces are smooth and free from cracks, holes, ridges, and other defects that might prevent adhesive bond or impair durability or appearance of the flooring material.

D. Inspect subfloors prior to installation to determine that surfaces are free from curing, sealing, parting and hardening compounds; residual adhesives; adhesive removers; and other foreign materials that might prevent adhesive bond. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.

E. Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.

F. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the subfloor. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.

3.03 PREPARATION

A. Subfloor Preparation: Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, and other defects with Fast-Setting Cement-Based Patch and Underlayment as recommended by the flooring manufacturer.

B. Subfloor Cleaning: The surface shall be free of dust, solvents, varnish, paint, wax, oil, grease, sealers, release agents, curing compounds, residual adhesive, adhesive removers and other foreign materials that might affect the adhesion of resilient flooring to the concrete or cause a discoloration of the flooring from below. Remove residual adhesives as recommended by the flooring manufacturer. Remove curing and hardening compounds not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring. Avoid organic solvents. Spray paints, permanent markers and other indelible ink markers must not be used to write on the back of the flooring material or used to mark the concrete slab as they could bleed through, telegraphing up to the surface and permanently staining the flooring material. If these contaminants are present on the substrate they must be mechanically removed prior to the installation of the flooring material. Refer to ASTM F 710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring for additional information on subfloor preparation.

C. Moisture Testing: Perform subfloor moisture testing in accordance with ASTM F 2170, Standard Test Method for Determining Relative Humidity in Concrete Slabs Using *in-situ* Probes and Bond Tests to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. On installations where both the Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained.

D. Concrete pH Testing: Perform pH tests on concrete floors regardless of their age or grade level. All test results shall be documented and retained.

3.04 INSTALLATION OF FLOORING

A. Install flooring in strict accordance with the latest edition of Manufacturers Installation Instructions. Failure to comply may result in voiding the manufacturer's warranty listed in Section 1.08.

B. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.

C. If required, install flooring on pan-type floor access covers. Maintain continuity of color and pattern within pieces of flooring installed on these covers. Adhere flooring to the subfloor around covers and to covers.

D. Scribe, cut, and fit or flash cove to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.

E. Adhere flooring to the subfloor without cracks, voids, raising and puckering at the seams. Roll with a 100-pound (45.36 kilogram) roller in the field areas. Hand-roll flooring at the perimeter and the seams to assure adhesion. Refer to specific rolling instructions of the flooring manufacturer.

F. Lay flooring to provide a minimum number of seams. Avoid cross seams, filler pieces, and strips. Match edges for color shading and pattern at the seams in compliance with the manufacturer's recommendations.

G. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.

H. Prepare heat-welded seams with special routing tool supplied for this purpose and heat weld with vinyl welding rod in seams. Use methods and sequence of work in conformance with written instructions of the flooring manufacturer. Finish all seams flush and free from voids, recesses, and raised areas.

3.05 INSTALLATION OF ACCESSORIES

A. Apply top set wall base to walls, columns, casework, and other permanent fixtures in areas where top-set base is required. Install base in lengths as long as practical, with inside corners fabricated from base materials that are mitered or coped. Tightly bond base to vertical substrate with continuous contact at horizontal and vertical surfaces.

B. Fill voids with plastic filler along the top edge of the resilient wall base or integral cove cap on masonry surfaces or other similar irregular substrates.

3.06 CLEANING

A. Perform initial and on-going maintenance according to the latest edition of Manufacturers Maintenance Recommendations and Procedures.

B. Refer to Section 018100 "Cleaning" for additional cleaning procedures

3.07 PROTECTION

A. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings.

END OF SECTION

SECTION 09 91 00 PAINTING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Unless otherwise directed, paint all exposed surfaces indicated on the drawings and herein.

B. Related Work:

1. Documents affecting work of this section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.

1.02 QUALITY ASSURANCE:

A. Include on Label of Containers:

1. Manufacturer's name;
2. Type of paint;
3. Manufacturer's stock number;
4. Color;
5. Instructions for reducing, where applicable;
6. Label analysis;
7. Federal Specification number

B. Sampling of Materials:

1. When requested by the A/E, obtain test samples from materials stored at project site or source of supply.
2. Select samples at random from sealed containers.

C. Fungus Control: Organic coating shall show no fungus growth when tested as specified in Federal Test Method Standard 141, Method 6271.1.

D. Field Quality Control:

1. Request review of first finished room, space, or item of each color scheme required by A/E for color, texture, and workmanship.
2. Use first acceptable room, space, or item as project standard for each color scheme.
3. For spray application, paint surface not smaller than 100 sq. ft. as project standard.

E. Paint Coordination:

1. Provide finish coats, which are compatible with the prime coats actually used.

2. Review other sections of these specifications as required verifying the prime coats to be used and assuring compatibility of the total coating system for the various substrata.
3. Upon request, furnish information of the characteristics of the specific finish materials to assure that compatible prime coats are used.
4. Provide barrier coats over noncompatible primers, or remove the primer and re-prime as required.
5. Prior to ordering paint materials, notify the Architect in writing of anticipated problems in using the specified coating systems over prime-coatings supplied under other sections.

1.03 SUBMITTALS:

A. Color samples;

B. Manufacturer's literature and recommendations, including flame spread ratings, fuel contribution and smoke density factors, including each wood specimen to be used.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver sealed containers with labels legible and intact.

B. Store only acceptable project materials on project site.

C. Store in a suitable location.

D. Restrict storage to paint materials and related equipment.

E. Comply with health and fire regulations.

F. Comply with pertinent other provisions of this Specification.

1.05 JOB CONDITIONS:

A. Comply with manufacturer's recommendations as to environmental conditions under which coatings and coating systems can be applied.

B. Do not apply finish in areas where dust is being generated.

C. Cover or otherwise protect finished work of other trades and surfaces not being painted concurrently or not to be painted.

D. Do not apply solvent-thinned paints when the temperature of surfaces to be painted and the surrounding air temperatures are below 45°F, unless otherwise permitted by the manufacturer's printed instructions as approved by the A/E.

E. Weather Conditions:

1. Do not apply paint when the relative humidity exceeds 85%; or to damp or wet surfaces, unless otherwise permitted by the manufacturer's printed instructions as approved by the A/E.

F. This Contractor shall move appliances and such, to paint behind same. Re-install when painting is completed.

1.06 EXTRA STOCK:

A. Upon completion of the work of this section, deliver to the Owner, as extra stock equaling 5 gallons of each color, type, and gloss of paint used in the work, tightly sealing each container, and clearly labeling with contents and location where used.

B. Each container shall be clearly marked as to the type of paint or stain, color name (and number), manufacturer's name, and where used. Said containers shall be clean of excessive paint and have airtight covers.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Except as otherwise specified, materials shall be the products of the following manufacturer:

1. Glidden Coatings
2. Benjamin Moore
3. Sherwin Williams

B. Materials selected for coating systems for each type surface shall be the product of a single manufacturer, unless otherwise indicated by the A/E.

C. Where products are proposed other than those specified by name and number in the painting schedule, provide submittals and a new painting schedule compiled in the same format used for the painting schedule in this section.

D. E.M.F. SHIELDING PAINT:

1. Cisco / Faraday Cage Room #2066 is to receive Electro-Magnetic-Frequency Shielding paint on all wall, floor, door, & ceiling surfaces (excluding glazing) prior to application and/or installation of finishes or finish paint (1-coat required).

2. Manufacturers & products listed below are acceptable or approved equal:

a. Woremor: RF-IE50-EMR

b. Y-Shield: HSF54-EMR

c. LBA Technology: CPC-54

3. Apply per manufacturer's recommendation. Provide grounding system with grounding straps & plates for paint per directives of the manufacturer and/or per the electrical drawings.

E. Undercoats and Thinners:

1. Provide undercoat paint produced by the same manufacturer as the finish coat.
2. Use only the thinners recommended by the paint manufacturer, and use only to the recommended limits.
3. Insofar as practicable, use undercoat, finish coat, and thinner materials as parts of a unified system of paint finish.

2.02 MATERIALS:

A. Paint shall be first quality of types and brands herein specified. The term "paint" as used herein includes enamels, primers, epoxy, fillers, transparent coatings, paint emulsions, stains, varnishes, sealers, and other coatings, organic or inorganic, whether used as prime, intermediate finish coats. Paint shall be well ground and shall be of such composition that it can be easily broken up with a paddle to smooth consistency.

B. Linseed oil, shellac, turpentine and other materials shall be of the highest quality as approved by the A/E.

C. Tints and all other additives or thinners shall be used only as recommended by the manufacturer of the paint as approved.

2.03 COLORS:

A. Colors of paints, including stain shades, shall be from manufacturer's standard colors. Architect shall select all colors.

2.04 MIXING AND TINTING:

A. Deliver paints and enamels ready-mixed to job site.

B. Accomplish job mixing and job tinting only when acceptable to the A/E.

C. Mix only in mixing pails placed in suitably sized non-ferrous or oxide-resistant metal pans.

D. Use tinting colors recommended by manufacturer for the specific type of finish.

E. Fungicidal agent shall be incorporated into the paint by the manufacturer.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Examine surfaces scheduled to receive paint and finishes for conditions that will adversely affect execution, permanence, or quality of work and which cannot be put into

an acceptable condition through preparatory work as include in Article 3.02 - PREPARATION OF SURFACES.

B. Do not proceed with surface preparation or coating application until conditions are suitable for timely and proper completion of this section.

3.02 PREPARATION OF SURFACES:

A. General:

1. Perform preparation and cleaning procedures in strict accordance with the paint manufacturer's recommendations as approved by the A/E and these Specifications.
2. Remove removable items, which are in place and are not scheduled to receive paint finish, or provide surface-applied protection prior to surface preparation and painting operations.
3. Following completion of painting in each space or area, reinstall the removed items by using workers who are skilled in the necessary trades.
4. Clean each surface to be painted prior to applying paint or surface treatment. ALL SURFACES TO BE PAINTED SHALL BE HAND WASHED WITH NON-SAPONIFYING SOLUTION SUCH AS TSP UNTIL ALL TRACES OF DIRT, OIL, OR GREASE HAVE BEEN REMOVED.
5. Before finishing doors and frames, Contractor shall remove all hardware. Re-install in accordance with door schedule and pertinent drawings.

B. Wood Surfaces:

1. Clean soiled surfaced with alcohol wash.
2. Except where rough exterior surface is specified, sand to smooth and even surface, and then vacuum off.
3. Apply specified product to all knots, pitch and resinous sapwood before priming coat is applied.
4. Fill nail holes, cracks, open joints, and other defects with oil based putty after priming coat has dried. Color to match finish color.
5. If a stain is used, prepare a small test area for product compatibility. Test for color acceptance. Stains shall be allowed to dry 24 hours before re-coating. Provide a light sanding with very fine sandpaper before application of finish.

C. Gypsum Wallboard and Plaster:

1. Fill narrow, shallow cracks and small holes with spackling compound and/or plaster.
2. Allow to dry; sand smooth.
3. Do not raise nap of paper on wallboard.

D. Concrete and Masonry Surfaces:

1. Fill cracks and irregularities with Portland cement grout to provide uniform surface texture.
2. Scrap or sand smooth any foam or concrete existing infill raised above wall surface.
3. Etch with 5% solution (by weight) of muriatic acid.
4. Fill concrete masonry unit surfaces with block filler.

E. Ferrous Metal Surfaces:

1. Prepare surface in accordance with recommendations and directions of manufacturer with rust-inhibitive primer.
2. Featheredges of sound paint by grinding, if necessary.

F. Galvanized Metal:

1. Clean surface with mineral spirits to remove oily residue.
2. Dry with clean cloth.

G. Synthetic Cementitious Finish:

1. Thoroughly wash and rinse surfaces. Dull glossy areas, sand and dust, remove loose paint, etc. Complete all preparation work in strict accordance with the manufacturer's written instructions.

H. Preparation of wood surfaces:

1. Remove wax, polish, dirt, grease, etc. by washing with detergent solution or wax removers. Rinse with clean water. Dry completely.
2. Sand with 120 - 130 fine sand paper, with the wood grain, remove all dust.
3. Whether new work (bare wood), or old work (previous finish), surface must be clean, smooth, wax-free, dust-free, and dry. Always sand old finish with fine sandpaper, sanding with the grain, remove all sanding dust before applying new finish.

3.03 MATERIALS PREPARATION:

A. General:

1. Mix and prepare paint materials in strict accordance with the manufacturer's recommendations as approved by the A/E.
2. When materials are not in use, store in tightly covered containers.
3. Maintain containers used in storage, mixing, and application of paint, in a clean condition, free from foreign materials residue and extreme temperatures.

B. Stirring:

1. Stir materials before application, producing a mixture of uniform density.
2. Do not stir into the material any film, which may form on the surface, but remove the film and, if necessary, strain the material before using.

3.04 PAINT APPLICATION:

A. General:

1. Touch-up shop-applied prime coats which have been damaged, and touch-up bare areas prior to start of finish coats application.
2. Slightly vary the color of succeeding coats.

a) Do not apply additional coats until the completed coat has been inspected and approved.
b) Only the inspected and approved coats of paint will be considered in determining the number of coats applied.

B. Do not apply initial coating until moisture content of surface is within limitations recommended by paint manufacturer - Test with moisture meter.

C. Apply paint, stain and varnish with suitable brushes, rollers or spraying equipment.

1. Rate of application shall not exceed that as recommended by paint manufacturer for the surface involved, less 10 percent.
2. Keep brushes, rollers, and spraying equipment clean, dry, free of contaminates and suitable for the finish required.
3. Comply with recommendations of product manufacturer for drying time between succeeding coats.
4. Sand and dust between each coat to remove defects visible from a distance of 5 feet.
5. Finish coats shall be smooth, free of brush marks, streaks, laps, or pile-up of paints, and skipped or missed areas.
6. Removable panels and hinged panels: Paint the back sides to match the exposed sides.
7. Paint both sides and all 4 edges of all doors.
8. Contractor shall be responsible for following manufacturer's written instructions and warnings for all products specified or substitutes herein.

D. Leave all parts of moldings and ornamental work clean and true to detail with no undue amount of paint in corners and depressions.

E. Make edges of paint adjoining other materials or colors clean and sharp with no overlapping.

F. Apply primer on all work before glazing.

G. Refinish whole wall where portion of finish has been damaged or is not acceptable.

H. Back prime all interior and exterior trim.

I. Runs on face are not permitted.

J. Wet Areas:

1. Add an approved fungicide to paints.
2. For oil base paints, use 1% phenolmercuric or 4% tetrachlorophenol.
3. For water emulsion and glue size surfaces, use 4% sodium tetrachlorophenate.

K. For completed work, match the approved samples as to texture, color, and coverage. Remove, refinish, or repaint work not in compliance with the specified requirements.

L. Miscellaneous Surfaces and Procedures:

1. Exposed Mechanical Items:

a) Paint electric panels, access doors, conduits, pipes, ducts, grills, registers, vents, and items of similar nature to match the adjacent wall and ceiling surfaces or as directed by the Architect.
b) Wash metal with solvent, prime, and apply two coats of the specified paint in accordance with the applicable paint schedule item, herein.

3.05 PAINT DRYING:

A. Allow sufficient drying time between coats, modifying the period as recommended by the materials manufacturer to suit adverse weather conditions.

B. Consider oil-base and oleo-resinous solvent-type paint as dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and when the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

3.06 APPLICATION EQUIPMENT:

A. For application of the approved paint, use only such equipment as is recommended for application of the particular paint by the manufacturer of the particular paint, and as approved by the A/E.

B. Prior to use of application equipment, verify that the proposed equipment is actually compatible with the materials to be applied, and that the integrity of the finish will not be jeopardized by the use of the proposed equipment.

C. Brush Applications:

1. Brush out and work the base coats onto the surface in an even film.
2. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, and other surface imperfections will not be acceptable.

D. Spray Application:

1. Except as specifically otherwise approved by the A/E, confine spray application to metal framework and similar surfaces where hand brush work would be inferior.
2. Where spray application is used, apply each coat to provide the hiding equivalent of brush coats.
3. Do not double back with spray equipment to build up film thickness of two coats in one pass.

E. Roller Application:

1. Rollers may be used on large wall and ceiling surfaces. Keep walls free of roller marks.

3.07 CLEANING:

A. Touch up and restore finish where damaged.

B. Remove spilled, splashed, or splattered paint from all surfaces.

C. Do not mar surface finish of item being cleaned.

D. Leave storage space clean and in condition required for equivalent spaces in project

E. Cleaning up process shall proceed with progress of work.

3.08 PAINTING SCHEDULE:

A. Surfaces not to be painted:

1. Pre-finished wall, suspended acoustical tile ceiling system, and floor coverings, unless otherwise indicated.
2. Items with factory-applied final finish unless otherwise noted.
3. Concealed ducts, pipes, and conduits unless otherwise noted.
4. Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, lead-coated copper, bronze, and similar finished materials will not require painting under this section except as may be so specified.
5. Do not paint over required labels or equipment identification performance rating, name, or nomenclature plates.

B. Areas shall be painted as indicated, as directed, and as approved. The kinds of painting materials and number of coats required on various surfaces shall be as indicated in the following schedule.

NUMBER OF COATS INDICATED HEREINAFTER ARE MINIMUM. COMPLETE COVERAGE IS REQUIRED. PROVIDE ADDITIONAL COATS TO AREAS WHICH DO NOT SHOW COMPLETE COVERAGE WITH SPECIFIED COATS. REFER TO ROOM FINISH AND COLOR SCHEDULE ON DRAWINGS FOR LOCATIONS OF THE FOLLOWING PRODUCTS:

1. New Interior Plaster and Gypsum Board: (where applicable)
   1st coat: Pratt & Lambert, #Z3001 Latex Primer
   (2) coats: Pratt & Lambert, #Z9391, Pro-Hide Plus Latex.

2. New Interior Wood Trim:
   (3) coats: Pratt & Lambert, #Z9691, Pro-Hide Plus Latex Satin Enamel.

3. Interior Spot Priming: (at stains)
   Apply coats as required, Pratt & Lambert, Q-Dee, #E12, primer sealer stain killer.

   NOTE: All surfaces shall be spot primed as necessary so as to prevent stains from "bleeding" through new paint finish.

4. Interior Stain: (wood trim, doors as noted, window sills, etc.)
   Pratt & Lambert, Tonetic Architectural Wood Stain, color shall be selected by the A/E.

5. Interior Painted Metal Doors and Frames:
   1st coat: 61 Enamel Undercoating
   2nd coat: Cella-tone Alkyd Satin Enamel
   3rd coat: Cella-tone Alkyd Satin Enamel

   NOTES: If rust is showing on metal, first coat shall be a rust inhibitive primer after proper preparation has been made. Spray paint radiator covers

6. Interior Masonry Units:
   1st coat: Pro-Hide Plus Latex Block Filler
   2nd coat: Accalade Velvety Latex Enamel
   3rd coat: Accolade Velvety Latex Enamel

7. Wet Areas - Interior Dry Wall, Plaster, Plasterboard, Masonite, Pressboard, Boiler Covering, Pipe Covering, etc. – Unless otherwise directed on the drawings:
   1st coat: Interior Acrylic Primer 23000
   2nd & 3rd coat: Accalade Velvety Latex Enamel

8. Exposed Piping (coordinate with CCRI standards):
   Color code pipes as follows:

Heating supply and return	Orange	
Domestic hot water.....	Dark Blue	Effecto Enamel
Domestic cold water.....	Violet	OSHA
Domestic water circulation.....	Dark Blue	Safety Color
Fire Protection.....	Red	
Gas.....	Gray	
Compressed Air.....	Yellow	

9. Exposed Fire Sprinkler Protection System Piping at Ceiling, Hangers, Hanger Rods, Fittings, Etc. (coordinate with CCRI standards):

1st coat:	Cleaner Manufacturer: Sherwin Williams "ProClean" or "TSP". Spray-on, thoroughly wipe clean with damp sponge or cloth. In heavily soiled location, rinse with water after wiping. Comply completely with other recommendations of the manufacturer.
2nd coat:	Apply (1)-coat Sherwin Williams "Kem Kromik" Universal Metal Primer. Color: Off-White – BSO WZ1
3rd coat:	Apply (2)-coats Sherwin Williams "DTM" Acrylic Coating: Semi-gloss: Color shall be selected by the Architect to match ceiling color.

NOTE: Comply fully with the painting procedures specified on the drawings & per CCRI standards.

3.09 OTHER SURFACES:

A. Surfaces for which the type of paint has not been specified shall be painted as specified for surfaces having similar conditions of exposure.

3.10 FINISH PAINT AT CISCO/FARADAY CAGE ROOM #2066

A. Cisco / Faraday Cage Room #2066 is to receive finish paint over, and compatible with Electro-Magnetic-Frequency Shielding paint on painted surfaces to match typical paint finishes per typical application methods.

END OF SECTION

SECTION 10 10 00 WRITING SURFACES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Provide "Whiteboard" Surfaces where indicated on the drawings, herein and as required for a complete and proper job.

B. Related Work Specified Elsewhere:

1. Documents affecting work of this Section, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.02 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. Use single source for whiteboards and accessory items.

1.03 SUBMITTALS:

A. Comply with pertinent provisions of Section 013000.

B. Samples:

1. 3 × 5 inch piece of whiteboard material, showing color, texture, and thickness of porcelain or gauge of metal, thickness and type of core material, and thickness of backing sheets.
2. One of each type wall clip or anchoring device.
3. One of each type accessory specified.

C. Shop Drawings:

1. Include location, type, dimensions, arrangement, whiteboard surface, and related materials.
2. Indicate backing anchor, mounting details, trim and accessories.

D. Manufacturer's Literature:

1. Printed technical specifications, catalog data, and details of products.
2. Recommended installation and maintenance instructions.

E. Certificates: Manufacturer's certificates that materials comply with specification requirements.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING:

A. Comply with pertinent provisions of Section 016400.

B. Store materials flat on blocking or supports to retain original shape.

1.05 GUARANTEE:

A. Manufacturer's warranty: Ten (10)-year.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Acceptable Manufacturers:

1. Epson
2. Aarco
3. Ghent
4. Claridge

2.02 MATERIALS:

A. WhiteBoard System

1.	Size:	As designated on the drawings.
2.	Frame:	Aluminum
3.	Construction:	Steel-backed and square miter corners
4.	Surface Material:	Gloss Porcelain surface; combination projection and dry-erase surface. Color to be white.
5.	Mounting:	Wall Mounted

PART 3 - EXECUTION

3.01 INSPECTION:

A. Prior to installation, inspect supporting construction and grounds to assure reinforcement is sufficient for installation of liquid writing surfaces, chalkboards and bulletin boards.

B. Check surface conditions to assure that they are:

1. Free from dust, dirt, or scaling paint;
2. Free from projections or depressions that affect a smooth installation

C. Do not proceed with installation until deficiencies are corrected.

3.02 INSTALLATION:

A. Keep perimeter lines straight, plumb, and level and in plane of wall.

B. Form straight joints, equal distances on each wall.

C. Fit whiteboards accurately and neatly around projections and outlet boxes.

D. Install anchor clips and brackets at minimum 24 inches o.c.

3.03 CLEAN-UP:

A. Clean whiteboards to original finish after installation.

END OF SECTION

SECTION 10 25 00 FIRE EXTINGUISHERS, CABINETS AND ACCESSORIES

PART 1 - GENERAL

1.01 DESCRIPTION:

A. Work specified in this Section includes provision for single fire extinguishers and surfaced mounted cabinets.

1.02 RELATED WORK

A. Documents affecting work of this Section, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1.03 SUBMITTALS

A. Submit for A/E's approval, in accordance with the supplementary general conditions, cuts from manufacturer's data showing component details, general arrangements, and methods of anchoring, finish, and dimensions.

PART 2 - PRODUCTS

2.01 FIRE EXTINGUISHERS

A. Extinguishers shall be surface mounted and portable, CCRI standard or as manufactured by J.L. Industries; 4450 W. 78th Street Circle; Bloomington, MN 55435; Phone: (612) 835-6859. Model #: Cosmic 10E, 10 pound capacity.

B. Quantity & Location: At all previous locations and/or as directed by the Fire Marshall.

C. Fire Classification: All purpose, Class ABC dry chemical.

D. Brass valve and stem, steel handles, mild carbon steel cylinder, red enamel finish and U.L. approved.

E. Accessories: Provide related surface wall mounting brackets, fasteners, etc. as required to install surface mounted extinguishers.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install cabinets in line with block coursing or blocking. Top of extinguisher is to be installed in such a manner that the fire extinguisher handle is 48 inches above the floor, except where indicated otherwise.

B. Fasten securely in place.

END OF SECTION

SECTION 10 44 00 INTERIOR SIGNAGE

PART 1 - GENERAL

1.01 SUMMARY

A. Provide interior signs at all rooms accessed by Corridor #2000 and as directed by Owner and/or Architect.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

1.03 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Classroom Signs:

1. Signage is to match existing 3rd floor corridor signage immediately above project level. As a minimum, signage is to be plastic ADA-compliant raised copy and braille core plies in contrasting colors, in finishes and color combinations, as selected from the manufacturer's standards to match existing classroom signage.

a) Signs to have 5/8-inch high letters raised 1/32-inch, accompanied by Grade 2 braille, 8" x 8" signs to have a 6-inch area for pictograms.
b) Mounting with double face tape.

PART 3 EXECUTION

3.01 INSTALLATION

A. Signs:

1. Locate sign units and accessories using mounting methods of the type described and in compliance with the manufacturer's instructions.

a) Install signs level, plumb, and at the height corresponding to center-line of signage at 60" a.f.f., with sign surfaces free from distortion or other defects in appearance.

b) Vinyl-Tape Mounting: Use double-sided foam tape to mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.

3.02 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

END OF SECTION

12 32 00 – MANUFACTURED CASEWORK

PART 1 - GENERAL

1.01 SUMMARY

A. The subsequent specifications are designed to describe to the provider of the laboratory casework system the standards and expectations that the owner and architect allow for a quality and functional installation of the laboratory casework.

B. This Section includes wood laboratory casework, countertops, fixtures and accessories.

C. Related Sections include the following:

1. Division 09 65 16 "Resilient Flooring – Vinyl Sheet Flooring"
2. Division 21000 Fire Protection
3. Division 22 000 Plumbing
4. Division 23000 Mechanical
5. Division 26000 Electrical
6. Related Work To Be Performed By Others:

a) Final installation of all plumbing, service and electrical fixtures attached to casework or countertop (excluding piping and wiring within fume hoods).
b) Final connection to service lines of all plumbing, service and electrical fixtures attached to laboratory casework or furniture.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For cabinets and countertops. Include plans, elevations, details, and attachments to other work. Show materials, finishes, filler panels, hardware, edge and backsplash profiles, cutouts for plumbing fixtures, and methods of joining countertops.

C. Samples for Selection: Manufacturer's color charts showing the full range of colors, textures, and patterns available for each type of material indicated.

1. Wood-veneered panels with transparent finish, 8 by 10 inches (200 by 250 mm), for each species.
2. Solid wood with transparent finish, 50 sq. in. (300 sq. cm), for each species.
3. Epoxy resin material for countertops, 6 inches (150 mm) square.
4. Painted steel panels, 8 by 10 inches (200 by 250 mm), for each color.
5. One unit of each type of exposed hardware.

D. Maintenance Data: For countertops and finishes to include in maintenance manuals specified in Division 1.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing wood cabinets similar to those indicated for this Project and with a record of successful in-service performance.

B. Source Limitations for Cabinets: Obtain laboratory casework, including tops and accessories, through one source from a single manufacturer.

1.04 COORDINATION

A. Coordinate layout and installation of blocking and reinforcement in partitions for support of laboratory casework.

B. Obtain templates for sink cutouts with plumbing contractor.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver laboratory casework until painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas.

B. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with polyethylene film or other protective covering.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not install laboratory casework until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Established Dimensions: Where laboratory casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Provide fillers and scribes to allow for trimming and fitting.

C. Field Measurements: Where laboratory casework is indicated to fit to existing construction, verify dimensions of existing construction by field measurements before fabrication and indicate measurements on Shop Drawings. Provide fillers and scribes if necessary.

D. Field Measurements for Countertops: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.07 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of table systems that fail in materials or workmanship within specified warranty period.

1. Two years from date of Final Completion.

PART 2 - PRODUCTS:

2.01 MANUFACTURERS AND PRODUCTS

A. Manufacturer: To establish a standard of quality, design and function desired, Drawings and specifications have been based on New England Laboratories, Mott Manufacturing LTD, Lexington Series casework. At the Contractor's option, casework complying with the material and construction requirements specified herein may be provided from the following listed manufacturers, or approved equal:

1. Mott Manufacturing LTD.
2. Kewaunee Scientific Corporation
3. ICI Scientific

2.02 WOOD CABINETS

A. MATERIALS

1. Exposed Wood Species: As follows. Do not use two adjacent exposed faces that are noticeably dissimilar in color, grain, figure, or natural character markings.

a) Maple plain sliced veneer.

2. Veneer Plywood: Hardwood plywood complying with HPVA HP-1 with face veneer of species indicated, selected for compatible color and grain with Grade A faces and Grade 1 backs of same species as faces.

a) Edge band exposed edges with minimum 1/8 inch thick, laminated wood edging of same species as face veneer.

3. Veneer Particleboard: Hardwood plywood complying with HPVA HP-1 with face veneer of species indicated, selected for compatible color and grain with Grade A faces and Grade 1 backs of same species as faces.

a) Edge band exposed edges with minimum 1/8 inch thick, laminated wood edging of same species as face veneer.

4. Thermoset Decorative Panels: Medium-density particleboard complying with ANSI A208.1, Grade M-2; with surface of thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

B. CABINET CONSTRUCTION

1. Face Style: Flush overlay; door and drawer faces cover cabinet body members or face frames with only enough space between faces for operating clearance.

2. Face Frames: Frameless.

3. Base Units

   a) Cabinet Ends: 3/4" veneer plywood with 1/8" laminated wood edge on all exposed surfaces.
   b) Front Top Rail: 3/4" x 4" veneer plywood with 1/8" laminated wood edge and fastened to cabinet ends with minimum six dowels.
   c) Rear Top Support Rails: 3/4" x 9" veneer plywood fastened to cabinet with minimum six dowels.
   d) Bottom Support Rails: 3/4" x 4" veneer plywood fastened to cabinet with minimum six dowels.
   e) Toe Space Rail: 3/4" x 4" veneer plywood fastened to cabinet ends with pocket screws to form a 4" high x 3" deep toe space.
   f) Cabinet Bottoms: 1" solid wood with 1/8" laminated edge, set flush and fastened to cabinet ends with dowels at 64mm max spacing.
   g) Cabinet Backs on Closed Cabinets: Removable 3/4" veneer plywood. Cabinet backs on open cabinets will match the species and grade of the cabinet body and will be 1/2".
   h) Vertical Dividers: Full height dividers and half height dividers shall be 1-1/2" material of matching species and grade as cabinet body, secured to bottom, front top rail and rear top rail with staples and screws. Exposed edges to be veneered to match casework.
   i) Shelves: 1" heavy duty solid wood set on steel pin type shelf supports at 32mm spacing. Provide full depth shelves in standard cabinets and in open units.
   j) Drawer Construction: Fabricate drawer box back, front and sides of 1/2" 9 ply hardwood plywood and finish with the same laboratory grade finish as the cabinet. Use dovetail joinery on all four joints. Provide 1/2" birch plywood drawer bottom and groove into all four sides of the drawer box and glued into position. Fix drawer body to drawer front with screws.
   k) Door and Drawer Fronts: 3/4" veneer plywood banded on all sides with 1/8" edgeband to match cabinet face veneer.

4. Wall and floor cases

   a) Case Ends: 3/4" veneer plywood with 1/8" laminated wood edges on exposed edges.
   b) Tops of Wall and Floor Cases: 3/4" veneer plywood with 1/8" laminated wood edges on exposed edges, fastened to ends with dowels at 64mm maximum spacing.
   c) Bottoms of Wall Cases: 1" solid wood with 1/8" laminated wood edges on exposed edges, with edging on exposed edge, set flush and fastened to

cabinet ends with dowels at 64mm maximum spacing. Cabinets at 36" wide or wider, bottoms shall be 1" thick.]

d) Bottoms of Floor Cases: 1" solid wood with 1/8" laminated wood edges on exposed edges, fastened to cabinet with dowels at 64mm maximum spacing.

e) Backs: 1/2" veneer plywood recessed and glued into rebates on all four sides.

f) Fixed Center Shelf on Floor Cases: 1" solid wood with matching veneer edges on exposed edges, on all open, hinged and sliding door cabinets. Fasten fixed center shelves to ends with dowels at 64mm maximum spacing.

g) Adjustable Shelves: 1" solid wood with matching veneer edges on front edges. Set on metal shelf pins at 32 mm spacing.

5. Doors:

a) Solid Doors:

1) 3/4" veneer plywood banded on all sides with 1/8" edgeband to match cabinet face veneer.

2) Provide two hinges on all doors up to 36" in height and a minimum of three hinges on any doors exceeding this height.

b) Framed Glazed Doors

1) Hinged Doors: 3/4" solid hardwood shaped to accept 5mm thick tempered glass on wall and floor cases.

2) Provide two hinges on all doors up to 36" in height and a minimum of three hinges on any doors exceeding this height.

3) Sliding Doors: Provide doors that slide in top channels with a nylon wheel operating on an inset plastic track.

4) Hold glass in place with a removable clear rubber panel retainer to facilitate change of damaged glass.

c) Unframed Sliding Glass Doors:

1) 6 mm tempered glass with all edges ground, set in extruded aluminum shoe with nylon wheel assemblies and top and bottom extruded aluminum track.

2) Provide silencer guides fitting on top of glass panel for smooth and noiseless operation.

3) Use adhesive backed pulls.

2.03 METAL CABINETS

A. MATERIALS

1. Galvanized Sheet Steel: Commercial quality galvanized sheet steel to ASTM 653, Designation Z275.

a) Required for all cabinets for extra corrosion resistance.

2. Glass: Clear float, 6mm and 3mm thick, conforming to CAN2 12.3-M76, glazing quality. Laminated glass: CAN/CGSB-12.1-M90, Type 1 with clear PVB interlayer. Total nominal thickness of laminated glass: 6 mm.

3. Sealant: One component, RTV silicone sealant. Color to suit application.

4. Finish: thermosetting laboratory grade power coat paint finish

5. Resilient Base and Adhesive:

   a) Base cabinets to be designed to work with 4" high base molding provided by others. Metal fillers for non-level floors shall be provided as required after installation and shall be added to the contract as agreed upon.

B. CABINET CONSTRUCTION

1. Materials and Thickness: Use the following minimum steel thicknesses for furniture manufacturing:

   a) 3mm (11 Ga) leveling bolt gusset plates.
   b) 1.9mm (14 Ga) drawer slides and side suspension channels.
   c) 1.5mm (16 Ga) for tubular rails, legs for tables, gusset plates, cabinet top and intermediate horizontal rails.
   d) 1.2mm (18 Ga) for door and drawer fronts, cabinet floor, cabinet sides, vertical front members, cabinet toe kick, service cover panels, table and kneehole frames, front rails, gable legs and dust caps, false panels, furring and filler panels.
   e) 0.9mm (20 Ga) for drawer backs, door backs, vertical closure channel, removable back panels, drawer bodies, drawer dividers, and bin bodies.
   f) All shelves to be manufacturer's heavy duty stock, minimum 1.9mm (14 Ga).

2. Cabinet Frame:

   a) Provide one-piece die-formed cabinet bottom construction with return side flanges turned down. Spot weld flanges to cabinet sides. Provide sink cabinets with galvanized bottom painted to match cabinet.
   b) Cabinet bottoms shall be turned down at front to form 32mm (1-1/4") "U" channel to accept toe kick and turn down 133mm (5-1/4") at back with 16mm (5/8") return to form the back lower member of cabinet base. Provide punched 19mm (3/4") dia. corner holes for access to levelers and to accept PVC press plugs. It shall be possible to access levelers from above cabinet without removing drawers or drawer supports.
   c) Provide additional vertical 75mm (3") "HAT" shaped channels, spot-welded to or formed with the rear vertical corner. Channel shall be provided with pre-punched holes to receive shelf clips, and slotted holes to receive drawer suspension tracks. Cabinets 762mm (30") wide and larger shall be provided with intermediate 117mm (4-5/8") "HAT" channels to brace cabinet and accept shelf clips and drawer tracks
   d) Where applicable, the front corner posts shall be pre-punched and slotted to accept drawer suspension systems and suspension pull-out shelves.

Front vertical posts shall form inboard flush front construction for doors and drawers acting as the cabinet main member side gable tying the cabinet bottom and horizontal member together to form a rigid case. Front post rear closure channels shall be "J" shaped 9mm (11/32") x 33mm (1-5/16") x 49mm (1-15/16"). Provide channel with pre-punched holes to receive shelf clips.

e) Doors and drawers shall overlay top intermediates and floor horizontal members.

f) Top horizontal front framing member shall form a "J" shaped section 75mm (3") wide, 10mm (3/8") return by 25mm (1") deep with 16mm (5/8") return.

g) Intermediate horizontal framing members shall form a "U" 32mm (1-1/4") high with a 25mm (1") return on top and 16mm (5/8") return on bottom.

h) Top rear horizontal framing member shall be 50mm (2") x 32mm (1-1/4") angle section welded to back corner lapped post and side gables with welded corner gusset plates acting as cabinet bracing and counter top material fixing member.

i) Enclose cabinetry toe space shall be 75mm (3") deep x 100mm (4") high and shall act as a total enclosure to bottom of cabinet. Toe space section shall key up into "U" shaped front floor member and act as reinforcement. Toe space, front floor of cabinet and corner post sections shall be spot welded together forming one structural member. The toe space members, side gable returns, and back lower member shall form all welded structural corner to accept leveller gussets and 10mm (3/8") levelling bolts.

j) Cabinet construction shall be electro spot-welded to form a strong well-fitted, one-piece unit.

k) Exposed horizontal structural cabinet members between doors and drawers shall be unacceptable.

3. Base Cabinet Components:

a) Provide removable back panels for cupboard base cabinets. Provide partial back panels 229mm (9") in height to accommodate plumbing at sink units. When requested, provide back panels and security panels on cabinets requiring locks.

b) Shelving edges; turned down on all four sides 25mm (1"), and returned under on front and back 25mm (1"). Shelves 914mm (36") and longer shall be provided with "HAT' channel reinforcement at front edge.

c) Doors:

1) a) Fabricate doors of two telescoping metal panels, 19mm (3/4") thick, painted internally with a sound-deadening material extending continuously full-width, and top to bottom. Reinforce hinged side of door adequately with hinge machine screws to prevent sagging. Secure recessed hinges to cabinet posts with machine screws and concealed self-locking nuts. Provide nylon roller friction catches, mounted on horizontal top or intermediate

members pull side of doors. Provide each hinged door with two rubber bumpers.

2) Doors, drawers, tracks and back panels shall be replaceable in the field without requiring special tools.

3) All standard double door cabinets shall be designed without center stiles to maximize access to the cabinet.

4. Filler Panels:

a) Fabricate front filler panels complete with flanges on both sides and a 75mm x 100mm (3" x 4") toe space along the working face.

b) Scribe filler panels shall be flanged on one side and flat on the other, to be cut on jobsite to suit wall conditions, and shall fit into double angles secured to the wall. No visible mounting screws permitted.

c) Corner filler panels shall be a two-piece construction, one fixed panel and the other a variable panel to facilitate room dimensions. Each shall have flanges and an integral 75mm x 100mm (3" x 4") toe space filler to interlock with its counterpart.

d) End closing filler panels shall be flanged on one side 25mm (1") and secured to back of cabinet. The edge extending to wall shall be flat and fit into a double angle secured to wall. No visible mounting screws permitted.

2.04 HARDWARE

A. Wire Pulls: Provide brushed chrome steel 4" wire pulls. Mount drawer pulls horizontally and door pulls vertically.

B. Hinges:

1. Full overlay, 120° opening, concealed type, incorporating a self-closing feature. Mounting plate to provide three-way adjustment in door alignment.
2. Provide two hinges on doors up to 36" in height, three hinges on doors over 36" in height.

C. Drawer Slides:

1. Provide full extension drawer slides with telescopic movement on ball bearings. Provide finger release disconnect for easy removal. Provide slide with a minimum dynamic load rating of 200 lbs in anachrome finish.

D. Locks: 5 pin (disc) tumbler cam locks with offset cam. Exposed face chrome plated.

1. Keying: Keyed alike and/or as directed by Dept. Heads.

E. Steel Shelf Pins: Provide Hafele 282.04.711 or Approved Equal

F. Levelers: Provide Outwater plastic #LL-158-3 or Approved Equal

G. Label Holder

1. Provide steel label holder with nickel finish for all door and drawer fronts.

2.05 FINISHES

A. Provide a laboratory grade, chemically resistant, non-flame spreading, acid curing catalytic lacquer finish.

B. Apply sealer to all exposed and semi-exposed surfaces.

C. Sand all finished surfaces with a fine sandpaper between each application of sealer and finishing lacquer.

2.06 EPOXY RESIN WORK SURFACES

A. Fabrication:

1. Fabricate tops and accessories in accordance with manufacturer's recommendations, approved Shop Drawings, and SEFA 8
   a. Sheets cast from modified epoxy resin and non-asbestos inert fillers; compounded mixture cured and thermoset specifically from formulation to provide exceptional physical and chemical resistance required in medium to heavy duty laboratory environments.
   b. Thickness
      1) 1 inch thick unless otherwise indicated. Check each sheet at factory for required thickness. Maximum variation in thickness: plus or minus 1/16 inch (1.6 mm) from corner to corner
   c. Shop fabricate in longest practical lengths.
   d. Bond joints with highly chemical resistant cement with properties and color similar to base material.
   e. Provide 1/8 inch (3 mm) drip groove at underside of exposed edges, set back 1/2 inch (13 mm) from face. Finish exposed edges.
   f. Fabricate tops flat
   g. Edge treatment: Standard 1/8 inch (2 mm) chamfered edge.
   h. Corner treatment: exposed corners shall be eased slightly for safety.
   i. Back and end splashes:
      1) Supplied loose for field installation.
      2) Same material and thickness as worksurfaces.
      3) 4 inches (100 mm) high unless otherwise indicated.
      4) Top-mounted end splash where worksurfaces abut adjacent construction at and locations indicated on Drawings.

2. Warpage:
   a. Inspect tops for warpage prior to fabrication by placing on true flat surface.

b. Maximum allowable warpage: 1/16 inch (1.5 mm) in 36 inch (900 mm) span or 3/16 inch (4.5 mm) in 96 inch (2400 mm) span.

B. Accessories

1. Provide the following solid epoxy resin components where indicated:

a. laboratory shelving
b. laboratory fume hood base work surfaces
c. pegboards

2. Installation Materials: Manufacturer's joint adhesive, panel adhesive, and sealants as required to suit project conditions.

2.07 FIXTURES

A. Epoxy Resin Sinks:

1. Mold sinks from thermosetting epoxy resin.
2. Mold interior corners to radius. Slope sink base to drain outlet.
3. Provide 1-1/2 inch (38 mm) outlet with open ended standpipe; standpipe overflow 2 inches (50 mm) shorter than depth of sink.
4. Unless otherwise indicated, fabricate sinks of drop-in design supported by upper flange from work surface. Top of flange to sit flush with top of adjacent work surface.
5. Color: To match adjacent work surface.
6. Sizes: Refer to drawings for sizes

2.08 MECHANICAL SERVICE FIXTURES

A. Service Fixtures. Provide fixtures complete with washers, locknuts, unions, nipples and other accessories for positive mounting to supporting laboratory units. Include wall and deck turrets and flanges, escutcheons, and similar items required. Provide turrets and flanges with non-removable pins or screws to prevent turning the fixture on the deck or wall. Factory assemble all fixtures (including the assembly of valves and shanks to turrets, flanges and other mounting accessories) and individually factory test each fixture in the manner set forth below. Secure threaded connections with setscrews or cement. Provide service fixtures (including valves and fittings used in fume hoods) and safety equipment by one service fitting manufacturer.

1. Fixture Cut Outs / Openings – The General Contractor is responsible for all cut outs and openings in the casework for mechanical fixtures and outlets. Coordinate with the electrical specifications and drawings.

B. Material and Finish. Fabricate service fixtures from cast brass containing a minimum of 85% copper or forged brass containing a minimum of 60% copper.

1. Finish service fixtures and safety equipment as follows:

a. Exposed Surfaces: Polished chrome plated.

2. Exposed Surface of Fittings Inside Fume Hoods: Epoxy powder coated in color to match the fixture service index color (or other color acceptable to architect).

C. Turret Handles. Except as otherwise noted, provide forged brass four-arm style handles on all fixtures. Provide handles with a screw-on index disc that is color-coded to match the fixture service index color.

1. Where wrist blade handles for water fixtures are desired, designate by the suffix "BH".
2. Provide laboratory ball valves and ground key cock valves with a forged brass lever-type handle which visually indicates the position of the valve.
3. Provide combination cold water/gas fixtures with a molded nylon hooded style handle.

D. Service Outlet Identification. Provide a colored plastic index disc with embossed identification letters at each service fixture handle. Secure index discs with cement so as to be tamperproof. Color code index discs as follows:

Service	Index Color	Letter Color	Symbol
Cold Water	Green	White	CW
Hot Water	Red	White	HW
Gas	Blue	White	GAS
Air	Orange	White	AIR
Vacuum	Yellow	Black	VAC
Nitrogen	Brown	White	NIT
Steam	Black	White	STM
De-ionized Water	White	Black	DI
Other Services	On Application		

E. Laboratory Ball Valves. Provide units with a forged brass body with non-removable serrated hose end, integral check valve and oversize lever-type handle. Provide valves with a chrome-plated ball with integral stem and molded TFE seals. Individually factory test ball valves at 125 PSI air pressure and provide rating of 75 PSI air working pressure. Where used for natural gas service, ball valves shall be certified by the American Gas Association (AGA) to 1/2 PSI working pressure.

F. Goosenecks.

1. Cup sinks and Lab Sinks: Refer to drawings.

G. Serrated Hose Ends. Provide serrated tip fittings with a 3/8" IPS thread with the hose end being tapered and provide not less than ten serrations. Provide 1/8 inch diameter orifice in serrated tip, except where otherwise specified. Provide serrated tip of round design and cement in place to be non-removable.

H. Vacuum Breakers. Where indicated by model number, provide ASSE-certified vacuum breakers on water fixtures. Provide vacuum breakers with an ultra-light float cup, silicone vent disc and replaceable seat. Provide the vacuum breaker bonnet with self-locking threads and vandal resistant cover screws.

2.09 ELECTRICAL SERVICE FIXTURES ACCOMODATIONS

A. Fixtures Cut Outs / Openings – The General Contractor is responsible for all cut outs and openings in the casework for electrical fixtures and outlets. Coordinate with the electrical specifications and drawings.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcement, and other conditions affecting performance of wood laboratory casework installation.

1. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install plumb, level, and true; shim as required, using concealed shims. Where laboratory casework abuts other finished work, apply filler panels for accurate fit, with fasteners concealed where practical.

B. Base Cabinets: Set cabinets straight, plumb, and level. Adjust subtops within 1/16 inch (1.5 mm) of a single plane. Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions with fasteners spaced 24 inches (600 mm) o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch (1.5 mm).

1. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced 24 inches (600 mm) o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than 2 fasteners.

C. Wall Cabinets: Hang cabinets straight, plumb, and level. Adjust fronts and bottoms within 1/16 inch (1.5 mm) of a single plane. Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 24 inches (600 mm) o.c. Align similar adjoining doors to a tolerance of 1/16 inch (1.5 mm).

D. Install hardware uniformly and precisely. Set hinges snug and flat in mortises, unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

E. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.03 INSTALLATION OF TOPS

A. Field Jointing: Where possible, make in the same manner as shop jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project site processing of top and edge surfaces is not required. Locate field joints where shown on approved Shop Drawings.

B. Secure epoxy tops to cabinets with epoxy cement, applied at each corner and along perimeter edges of not more than 48 inches (1200 mm) o.c.

C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection. Provide flush hairline joints in tops using clamping devices.

1. Where necessary to penetrate tops with fasteners, countersink heads approximately 1/8 inch (3 mm) and plug hole flush with material equal to top in chemical resistance, hardness, and appearance.

D. Provide required holes and cutouts for plumbing and electrical fixtures.

E. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

F. Provide scribe moldings for closures at junctures of top, curb, and splash, with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.

3.04 ADJUSTING AND CLEANING

A. Adjust casework and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

B. Clean casework on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Protection: Provide 6-mil (0.15-mm) plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at minimum of 48 inches (1200 mm) o.c.

END OF SECTION

SECTION 12 50 50 WINDOW TREATMENTS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This section includes the following window treatment types and all related hardware and accessories:

1. Window shades
2. Drapery and Curtains Hardware

B. Related Work Specified Elsewhere:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these specifications.

1.02 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. All workmanship, details and procedures shall comply with manufacturer's recommendations.

C. The Contractor shall furnish and install, as required, all rough blocking to receive finish hardware, for a complete and proper installation.

1.03 SUBMITTALS:

A. Comply with pertinent provisions of Section 01300.

B. Product Data: After the Contractor has received the Owner's Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this Section.
2. Manufacturer's specifications and other data needed to provide compliance with the specified requirements.
3. Manufacturer's recommended installation procedures which, when approved by the A/E, will become the basis for accepting or rejecting actual installation procedures used on the work.
4. Color samples.

C. Samples: Accompanying the submittal described above, submit samples of each window treatment proposed to be used.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Comply with pertinent provisions of Section 01640.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. SFWContract (Model: Trueperformance).
B. MechoShade Systems, Inc (Model: Urban Shade).
C. Draper (Clutch Operated FlexShade).

2.02 MATERIALS:

A. Manual Window Shades:

1. Use: Premium fiber glass shade with 1% openness. PVC shades will not be accepted.
2. Contractor shall field verify all dimensions.
3. Provide prototype installation at each window type. Architect shall approve installation and shade prior to Contractor purchasing and proceeding with installation.

2.03 OTHER MATERIALS:

A. Provide other materials not specifically described but required for a complete and proper installation, as selected by the Contractor, subject to the approval of the A/E.

PART 3 - EXECUTION

3.01 SURFACE CONDTIONS:

A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION:

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this section.
B. Blind subcontractor shall be responsible for inspection of site, approval of mounting surfaces, installation conditions and field measurements for this work.
C. Installation shall comply with manufacturer's recommendations.

3.04 CLEANING:

D. Clean finished installation of dirt and finger marks. Leave work area clean and free of debris.

END OF SECTION

SECTION 21 00 00 – PLUMBING FIRE PROTECTION TABLE OF CONTENTS

210500 Common Work Results for Fire Suppression
211000 Water-Based Fire-Suppression Systems
220000 Plumbing

SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Piping materials and installation instructions common to most piping systems.
   2. Escutcheons.
   3. Fire-suppression equipment.
   4. Equipment installation requirements common to equipment sections.
   5. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Piping and fittings.
   2. Sprinklers,
   3. Hangers.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes with end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

B. Coordinate installation of required supporting devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE AND FITTINGS

A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install fittings for changes in direction and branch connections.

F. Select system components with pressure rating equal to or greater than system operating pressure.

G. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
      f. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
      g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

H. Sleeves are not required for core-drilled holes.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

END OF SECTION

SECTION 21 10 00 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following fire-suppression piping inside the building:
   1. Automatic Wet-pipe sprinkler systems.

1.3 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device.

1.4 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.

B. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.
   1. Margin of Safety for Available Water Flow and Pressure: 10 psi, including losses through water-service piping, valves, and backflow preventers.
   2. Sprinkler Occupancy Hazard Classifications:
      a. Building Service Areas: Ordinary Hazard, Group 1.
      b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
      c. General Storage Areas: Ordinary Hazard, Group 2.
      d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
      e. Office and Public Areas: Light Hazard.
   3. Minimum Density for Automatic-Sprinkler Piping Design:
      a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
      b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
      c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
   4. Maximum Protection Area per Sprinkler:
      a. Office Spaces: 225 sq. ft.
      b. Storage Areas: 130 sq. ft.
      c. Mechanical Equipment Rooms: 130 sq. ft.
      d. Electrical Equipment Rooms: 130 sq. ft.
      e. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.
   5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:
      a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
      b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Piping materials.

2. Pipe hangers and supports.
3. Sprinklers, Include sprinkler flow characteristics, mounting, finish, and other pertinent data.

B. Shop Drawings

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.

D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 25. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

E. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
   a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 25 “Standard For The Inspection, Testing And Maintenance Of Water – Based Fire Protection Systems”.
3. NFPA 101 “Life Safety Code”.

1.7 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.8 RECORD DRAWINGS

A. The contractor shall keep daily updated accurate records of all deviations in work as actually installed form work indicated on the contract drawings. Each Contractor shall record clearly, neatly, accurately, and promptly as work progresses the following data:
1. Changes made resulting from change orders or instructions or sketches issued by the A/E.
2. Changes in routing made to avoid conflict with other trades or structural conditions.
3. Final location of equipment and panels if different than contract documents.

B. The record drawings shall be kept at the job site, available to the owner at all times and labeled as “Project Record Information – Job Set”. When work is completed, one complete set of marked-up original prints, updated CADD drawings with all changes listed above and a CD with CADD files shall be delivered to the A/E for approval.

C. All CADD files requested by the Contractor will be given to the contractor upon completing a waiver application and submitted to the architect.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 STEEL PIPE AND FITTINGS

A. Threaded-End, Schedule 40 Steel Pipe: ASTM A 135 or ASTM A 795 or ASTM A 795 and ASME B36.10M, Schedule 40 wrought-steel pipe in NPS 2” and less.
   1. Cast-Iron Threaded Flanges: ASME B16.1.
   2. Malleable-Iron Threaded Fittings: ASME B16.3.

B. Grooved-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 2 ½” and greater; with factory- or field-formed, roll-grooved ends.
   1. Grooved-Joint Piping Systems:
      a. Manufacturers:
         1) Tyco Fire Suppression & Building Products
         2) Victaulic Co. of America.
         3) The Viking Corporation

      b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.

2.3 SPRINKLER SPECIALTY FITTINGS

A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have 250-psig minimum working-pressure rating if fittings are components of high-pressure piping system.

B. Outlet Specialty Fittings:
   1. Manufacturers:
      a. Tyco Fire Suppression & Building Products
      b. Victaulic Co. of America.

c. The Viking Corporation
d. Mechanical-T and -Cross Fittings: UL 213, ductile-iron housing with gaskets, bolts and nuts, and threaded, locking-lug, or grooved outlets.

2.4 SPRINKLERS

A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Sprinklers shall have 250-psig minimum pressure rating if sprinklers are components of high-pressure piping system.

B. Manufacturers:
1. Viking Corp.
2. Tyco Fire Suppression & Building Products
3. Victaulic Co. of America.

C. Automatic Sprinklers: Quick (fast) Response with heat-responsive glass bulb element complying with the following:
1. UL 1767, for early-suppression, fast-response applications.

D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
1. Open Sprinklers: UL 199, without heat-responsive element.
a. Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.

E. Sprinkler types, features, and options as follows:
1. Pendent sprinklers.
2. Quick-response sprinklers.
3. Upright sprinklers.

F. Sprinkler Finishes: Chrome plated and brass.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PIPING APPLICATIONS, GENERAL

A. Shop welded pipe joints where welded piping is indicated.

B. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

3.3 SPRINKLER SYSTEM PIPING APPLICATIONS

A. Standard-Pressure, Wet-Pipe Sprinkler System, 175-psig Maximum Working Pressure:
   1. Sprinkler-Piping Fitting Option: Specialty sprinkler fittings, NPS 2-1/2 and smaller, including mechanical-T and -cross fittings, may be used downstream from sprinkler zone valves.
   2. NPS 2” and Smaller: Threaded-end, black, Schedule 40 steel pipe; cast- or malleable-iron threaded fittings.
   3. NPS 2-1/2” to NPS 4” Grooved-end, black, Schedule 10 steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.4 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13 and NFPA 14.
      a. Shutoff Duty: Use ball, butterfly, or gate valves.
   2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13 and NFPA 14.
      a. Shutoff Duty: Use ball, butterfly, or gate valves.
      b. Throttling Duty: Use ball or globe valves.

3.5 JOINT CONSTRUCTION

A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping joint construction.

B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 (DN 200) with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.

C. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
   1. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.

3.6 PIPING INSTALLATION

A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install sprinkler piping with drains for complete system drainage.

E. Hangers and Supports: Comply with NFPA 13, 2010 for hanger materials.
   1. Install sprinkler system piping according to NFPA 13, 2010.

F. Fill wet-pipe sprinkler system piping with water.

3.7 VALVE INSTALLATION

A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

3.8 SPRINKLER APPLICATIONS

A. Drawings indicate sprinkler types to be used.
   1. Rooms without Ceilings: Upright and pendent sprinklers.

3.9 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

3.10 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.11 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.12 CLEANING AND PROTECTION

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

C. Protect sprinklers from damage until Substantial Completion.

END OF SECTION

SECTION 22 00 00 - INTERIOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. SECTION INCLUDES:
1. All cold and hot water piping
2. Final connections to all equipment
3. Natural Gas piping
4. Plumbing fixtures
5. All specialty and control valves
6. Insulation
7. Acid waste and vent system
8. Coordinate with Division 1 for coordination drawing requirements.
9. Temporary connections during construction.
10. Provide each system complete and ready for use.
11. Inspect, test and approve all piping before covering or concealing. No exceptions will be made.
12. Sterilization of water lines.
13. Other items in the work covered in other sections of the specifications, as shown and specified herein.
14. Final connections to plumbing fixtures as specified herein and all laboratory equipment requiring such connection

B. Provide all manufactured items and equipment in accordance with manufacturer's recommendations. Provide all necessary specialties and accessories, including anchors and supports.

C. Examine all sections of specification and drawings for requirements affecting the work of this section, as shown and specified herein.

1.3 DEFINITIONS

A. The term "capped flush" on existing piping means cap existing lines, concealed, beyond finish wall, ceiling or floor line, so proper finish can be applied.

B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, and unheated spaces immediately below roof, spaces above ceiling, unexcavated spaces, crawl spaces, and tunnels.

C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms

D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

E. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

F. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

G. The following are industry abbreviations for plastic materials:
   1. ABS: Acrylonitrile-butadiene-styrene plastic.
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. PE: Polyethylene plastic.
   4. PVC: Polyvinyl chloride plastic

H. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

I. “Furnish and install” and “Provide” means to supply, erect, install and connect in readiness for regular operation, the particular work referred to, unless otherwise specified.

J. “Underground” shall mean pipe, conduit or equipment that is buried exterior to or within the building.

K. “Finished grade” as used herein, means the final grade elevations indicated on the drawings.

L. Piping shall mean and include pipe, fittings, hangers, and valves.

M. Tempered water shall be considered the same as hot water throughout the specifications.

1.4 SHUTDOWNS

A. Coordinate all phases of the work with Owner and do all work with the least inconvenience to the Owner.

B. Coordinate all shutdowns with Owner and do all work, etc., under Owner's approved schedule.

C. Coordinate all shutdowns with Owner and do all work, etc., under Owner's approved schedule, including requirements for overtime.

1.5 EXISTING CONDITIONS

A. Bidders are advised to visit the site and inform themselves as to the existing conditions under which this work will be performed prior to submitting prices. Failure to do so, will, in no way relieve the successful bidder from the responsibility of furnishing any materials or performing any work in accordance with the true intent and meaning of the drawings and specifications.

B. No claim for extra compensation will be recognized if difficulties are encountered which an examination of the site conditions and contract documents prior to executing the contract would have revealed.

C. This Contractor shall be responsible for ordering and furnishing the correct quantity of material required. Routing and equipment arrangements shown on the drawings are approximate only and are not warranted to be accurate.

D. Arrangements shall be made with the Owner prior to the visit for inspection of the existing buildings.

E. Prior to submitting proposal, visit job site, verify and inspect existing conditions.

F. Examine building before commencing work and make known any damaged fixtures and/or piping which exists.

G. Field verify all inverts, sizes, locations, etc. at each location, prior to starting work.

H. Do not reuse piping, unless otherwise noted.

I. Remove and dispose of all plumbing fixtures, lab, equipment, piping (sanitary, vent, acid waste, acid vent, air, gas, water), etc. cap all lines in existing walls, floors, or ceilings not to be removed, flush with floors, walls, or ceilings as specified.

J. Provide temporary lines required during construction to keep existing systems in proper working order all at no additional cost.

K. Disconnect and reconnect at new locations all equipment and or fixtures that is to be relocated and provide all necessary valves, filters, fittings, regulators, reducers, etc., as required.

L. Correct and repair any damage to fixtures and piping at no additional cost.

M. Remove and dispose of piping in way of new construction. Cap or plug, as required.

N. Relocate piping, to remain, in way of new construction at no additional cost.

1.6 RELATED SECTIONS

A. Cutting and patching - Division 1.

B. Coring of holes and saw cutting in concrete and all X-ray work - Division 1.

C. Concrete work - Division 3.

D. Masonry work - Division 4

E. Fire-stopping – Division 7.

F. Access panels - Division 8.

G. Field painting of piping, hangers, etc. - Division 9.

H. Chilled water supply and return piping - Division 23.

I. Condensate piping - Division 23.

J. Heating connections, thermostats - Division 23.

K. Electrical connections - Division 26.

1.7 CODES, ORDINANCES AND PERMITS

A. Obtain all necessary permits and pay resultant fees. Provide copy of application to owner and architect.

B. All work performed under this section of the specifications shall be done in accordance with the applicable National, State of Rhode Island Plumbing and Energy Codes and local codes, laws and ordinances and State of Rhode Island Fuel Gas and Energy Codes.

C. All materials and work provided shall be in accordance with, but not limited to, the following:
   1. American National Standards Institute (ANSI).
   2. American Society for Testing and Materials (ASTM)
   3. Building Officials and Code Administrators (BOCA)
   4. National and State Electrical Code (NEC)
   5. National Electrical Manufacturer's Association (NEMA
   6. National Fire Protection Association Codes and Standards (NFPA)
   7. Occupational Safety and Health Act (OSHA)
   8. State Building and Handicapped Codes
   9. Standards of Underwriters Laboratories (UL)
   10. Warwick Sewer Authority Rules and Regulations

D. Where code references are given, the latest issue of that code in effect at the time of bidding shall be used. Code references given to indicate the minimum quality and performance acceptable. Where specifications and/or drawings indicate more stringent requirements, the specification shall govern.

E. Permits: Be responsible for filing all documents, payment of all fees and securing of all inspections and approvals necessary for the installation and operation of all systems furnished under this section.

1.8 PROTECTION

A. Protect materials, fixtures and fittings. Temporarily close all pipe openings to prevent obstruction and damage. Board over, water closets, lavatories and sinks and protect other fixtures with pasted-on paper.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

C. Post notices prohibiting the use of the fixtures prior to completion.

1.9 CUTTING AND FITTING

A. Do the cutting and fitting necessary for the installation of the plumbing work and maintain fire integrity of floor to floor construction.

B. Take care to prevent injury, discoloration or defacement of other finish materials; and do no cutting or fitting of finish material.

1.10 CLEANING

A. Upon completion of the installation, clean and remove all oil and debris. Clean and polish and leave bright all fixtures and metal work intended to be exposed. Clean out the piping systems and all fixtures, traps and cleanouts. Leave all work in perfect operating condition.

B. Should any pipe, duct or any part of the apparatus be stopped by refuse after the apparatus has been accepted, pay for the disconnecting, cleaning and reconnection, wherever necessary, for the purpose of location and removing the obstruction. Pay for repairs to adjoining work required thereby.

1.11 DRAWINGS

A. The drawings are diagrammatic, and not intended to show every detail of construction or arbitrary location of piping. Where building construction makes it advisable or necessary to change location of piping or fixtures, without increasing the scope of work, perform such work without additional cost, on written order or consent of the Engineer.

B. Install the work as shown. In case of conflict with building parts, or the work of other trades, immediately request a decision be rendered so that there may be no delay in the building construction.

C. Submit for written approval, single line diagrams of any proposed changes or modification to the drawings, at least one week before prices are due.

1.12 QUALITY ASSURANCE

A. Submit catalog cuts and brochures for approval of all proposed materials to be used on the project.

B. Materials and equipment under the section shall be new and of the best grade.
   1. Materials shall conform to the requirement of the State of Rhode Island Plumbing Code, local city requirements, and standards listed such as commercial USAS or ASTM and requirements specifically stipulated herein.

C. All plumbing products used within the domestic water system are to meet or exceed NSF/ANSI 61 Standard requirements for lead-free products.

D. Unless otherwise specified, apply and pay for all necessary permits, fees, and inspections required by any public authority having jurisdiction.

E. Submit copies of manufacturer's recommendation on installing pipe for approval.

F. In addition to other requirements specified herein, the Contractor shall furnish notarized test reports and methods of test by an approved independent testing laboratory to show compliance of all materials furnished under this section of the specifications with all specification requirements and pipe manufacturer's notarized certificates of conformance stating that all materials to be furnished under these items conform with all specification requirements. Each shipment of pipe and pipe fittings shall be accompanied with the pipe manufacturer's notarized certificate of conformance, certifying that the pipe and pipe fittings meet all requirements of the specifications. All testing of all materials furnished under this section of the specifications shall be provided by the Contractor at no additional expense to the Owner.

G. Where items of equipment and/or materials are specified or materials are specified or identified herein by manufacturer's names, model or catalog numbers, only such specified items may be used.

H. Submit, in booklet form, all plumbing fixtures and related accessories for any fixtures and/or equipment different than the manufacturers listed. Submit catalog cuts of both manufacturers.

I. Submit complete maintenance and operational charts and manuals for all equipment and fixtures specified, indicated or required for this work.

J. On completion of the work, attach 1-1/2" diameter brass or embossed plastic as manufactured by Seton Nameplate Company consecutively numbered tags to all valves, also furnish two (2) typewritten charts (framed and glazed) showing all valve numbers with their location and riser controls. Identify all equipment with laminated plastic (lamicoid) nameplates fastened to the equipment as approved. These numbered valves to be shown on Record Drawings.

K. Keep on file, at job site, a clean set of prints to clearly and accurately note all changes, wherever work is installed other than shown. After completion of work, provide a corrected set of drawings in PDF format on CD labeled "Record Drawings" and (2) sets of prints.

1.13 ACCESSIBILITY

A. Be responsible for sufficiency of shafts and chases, with adequate clearances for the proper installation of the work. Cooperate with all other contractors, whose work is in the same space, and advise the Contractor of all requirements. Keep such spaces and clearances to the minimum size required.

B. Locate all equipment, which must be operated, serviced or maintained, in fully accessible locations. Equipment includes, but is not limited to: valves, traps, cleanouts and drain points. If required for better accessibility, provide access doors. Make minor deviations to allow for better accessibility, however, review such changes with the Architect/Engineer.

1.14 COORDINATION

A. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section “Access Doors and Frames.”

1.15 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

A. Refer to General Conditions (and Supplementary Conditions), Shop Drawings, Product Data and Samples and add the following:
   1. Within thirty (30) days after the date of notice to proceed and before purchasing any materials or equipment, submit to the Architect for review, a complete list, in six (6) copies, of all materials to be incorporated in the work. This listing shall be arranged by the order of occurrence in the specifications, followed by the items on the drawings not specifically included in the specifications.
   2. After the list has been processed by the Architect, submit complete shop drawings and product data of all equipment. These submittals shall be submitted within thirty (30) days after the processing date of the original submittal list.
   3. All submittals shall be complete and shall be in three-ring loose-leaf binders. No consideration will be given to partial submittals, except with prior approval of the Architect. Each item shall have a cover page stating project, specification and paragraph reference number, of drawing reference number, and scheduled equipment identification number, if applicable.
   4. The review of submittals does not relieve this Contractor from the responsibility of shop drawing errors in details, sizes, quantities, wiring diagram arrangements and dimensions which deviate from the specifications, contract drawings, and/or job conditions as they exist.
   5. Changes to work already performed made necessary by delays in shop drawing review are the responsibility of this Contractor.
   6. Copies of equipment and system guarantees shall be submitted with shop drawing package.

B. Refer to General Conditions (and Supplementary Conditions) for substitution of equipment.

C. If apparatus or materials are substituted for those specified under this section, and such substitutions necessitate changes in or additional connects, supports or construction, same shall be provided at no additional cost to the Owner. This Contractor shall assume cost and entire responsibility thereof. Architect's permission to make such substitution shall not relieve this Contractor from full responsibility for work.

1.16 RECORD DRAWING

A. The General Contractor shall provide two (2) sets of black line on white record drawings to this Contractor, one set of which shall be maintained at the site and one set of which shall, at all times, be accurate, clear and complete, showing the actual location of all equipment and piping. The record drawings shall be available to the Architect's/Engineer's field representative at all times.

B. Any addenda sketches, supplementary drawings and change orders issued during the course of construction shall be transferred to the record drawings.

C. At the completion of this contract, this Contractor shall submit through the General Contractor an accurate checked set of record drawings.

D. Non-availability of record drawings or inaccuracies therein shall postpone the final inspection until they are available.

E. After approval of these record drawings, photo reproductions of the original tracings shall be revised to incorporate all the changes on the record drawings. These photo reproductions shall be certified by this Contractor as correct and delivered to the Architect together with two (2) sets of black line prints.

F. All costs related to the foregoing requirements shall be paid for this Contractor.

G. All valves shown on these drawings shall be numbered with numbers corresponding to those on the valve charts.

1.17 USE OF ELECTRONIC DRAWING FILES

A. If requested, the Engineer will provide electronic copies of selected CAD (Computer Aided Design) drawing files for the Contractor's use in the preparation of shop drawings, coordination drawings, or as-built drawings related to this project, subject to the terms and conditions in the following paragraphs.

B. The Engineer's electronic files are prepared on AutoCAD. The Engineer will provide drawing files through Release 2008.

C. Data contained on these electronic files is part of the Engineer's instruments of service and shall not be used by the Contractor or anyone else receiving this data through or from the Contractor for any purpose other than as a convenience in the preparation of shop drawings, coordination drawings, or as-built drawings for the referenced project. Any other use or reuse by the Contractor or by others will be at the Contractor's sole risk and without liability or legal exposure to the Engineer. In accepting these files, the Contractor shall agree to make no claim and shall waive, to the fullest extent permitted by law, any claim or cause of action of any nature against the Engineer, its officers, directors, and employees, agents of the Engineer, which may arise out of or in connection with the Contractor's use of the electronic files.

D. Furthermore, the Contractor shall to the fullest extent permitted by law, indemnify and hold harmless the Engineer from all claims, damages, losses and expenses, including attorney's fees arising out of or resulting from the Contractor's use of these electronic files.

E. These electronic files are not contract documents. Significant differences may exist between these electronic files and corresponding hard copy contract documents due to software incompatibility, software translation, addenda, change orders or other revisions. The engineer makes no representation regarding the accuracy or completeness of these electronic files. In the event that a conflict arises between the hard copy contract documents prepared by the Engineer and the electronic files, the hard copy contract documents shall govern. The Contractor is responsible for determining if any conflict exists.
   1. By use of these electronic files, the Contractor is not relieved of his duty to fully comply with the contract documents, including and without limitation, the need to check, confirm and coordinate all work with that of other contractors for the project.

F. Because of the potential that the information presented on the electronic files can be modified, unintentionally or otherwise, the Engineer reserves the right to remove all indication of their respective ownership and/or involvement form each electronic file provided.

G. A service fee of $100.00 per sheet shall be remitted directly to the Engineer prior to delivery of the electronic files. Arrangements shall be made directly with the Engineer for files prepared by them. Electronic files will not be released until payment is received. A written release to be prepared by the Engineer will be required as well.

H. Under no circumstances shall delivery of the electronic files for use by the Contractor be deemed a sale by the Engineer, who makes no warranties, either expressed or implied, of merchantability and fitness for any particular purpose. In no event shall the Engineer or its consultant (s) be liable for any loss of profit or any consequential damages arising out of the use of these electronic files.

1.18 WARRANTY

A. Refer to General Conditions and add the following:

   1. Standard equipment guarantees offered by the manufacturer for on (1) year or greater shall be in addition to that as required by this contract.
   2. Copy of manufacturer's equipment guarantees shall be submitted with this Contractor's written guarantee.

1.19 ALTERNATES

A. The Bid forms for General Bidders and Sub-Bidders provide space for the insertion of the amount to be added to or deducted from the Base Bid if the following alternates are accepted.

PART 2 - PRODUCTS

2.1 INDIRECT WASTE PIPING

A. Type L copper with copper DWV sweat fittings.

B. Plastic pipe, Schedule 40, DWV (ASTM D-1785 and ASTM D-2665), unless indicated otherwise.

2.2 CLEANOUTS

A. Provide raised square head cleanout plugs, where possible.

B. Provide Zurn ZN-1447-BP-VP for all areas where wall thickness is insufficient to install stainless steel or steel access doors, vandal proof, bronze plug.

2.3 WASTE AND VENT PIPING:

A. Aboveground Piping: (unless otherwise indicated)
   1. Solid plastic piping, PVC Schedule 40 DWV, Iron pipe Sizes (IPS) conforming to ASTM D-1785 and ASTM D-2665. PVC DWV solvent cement fittings are to conform to ASTM D-2665. Pipe and fittings are to be manufactured to the nominal dimensions cited in the applicable ASTM standard, and to be manufactured by one manufacturer.
   2. Foam core PVC piping is not allowed on this project. All foam core piping installed on project is to be removed and replace at no additional cost to owner.
   3. Provide chrome plating for all exposed piping to plumbing fixtures in classrooms, and finished rooms, etc., including chrome plated traps.
   4. Chrome plate all exposed traps and water supplies, whether insulated or not, including piping covered with Trap-Wrap.

2.4 TRAPS

A. Provide standard N.Y. Reg. "P" traps.

B. All fixtures with waste connections shall be properly trapped and vented in accordance with the requirements of the State Plumbing Code and Plumbing Inspector.

2.5 SLEEVES, INSERTS AND ESCUTCHEONS

A. For all openings required in concrete floors, concrete walls and masonry walls; install sleeves of proper size, or masonry is set. Provide wrought iron and steel pipe sleeves for all sleeves through floors or walls, sizes as approved, and packed as required. Extend sleeves one inch above floor for exposed piping passing through the floor.

B. Fit all exposed uncovered pipes passing through walls, in cabinets, floors and ceilings with chromium plated spun or split type escutcheons with clamping device for holding in position.

C. Typical for all piping.

D. This contractor is to verify that all fire stopping is compatible with each piping system.

E. Coordinate all sleeving requirements with fire stopping contractor.

F. Coordinate with Fire Stopping contractor all sleeving material types and sleeve sizes to conform to the appropriate U.L. fire-stopping details per the hourly requirements specified in Division 7. Sleeving is required for all piping through floors, walls install sleeves in accordance with manufacturer's printed instructions.

2.6 HANGERS AND ANCHORS

A. Support all piping from the building structure by means of approved hangers and cast iron concrete inserts or lag bolts. Support piping to maintain required grading and pitching of lines, to prevent

vibration and to secure piping in place, and arrange so as to provide for expansion and contraction. Provide approved anchors.

B. Provide all acid, waste, vent stacks and other pipe risers with friction clamp at each floor level and where required.

C. Provide clevis ring type hangers for piping with adjustable device, and machine threaded hanger rods. Provide copperized hangers for water piping. Size of rods shall follow schedule in NFPA Bulletin No. 13.

D. Provide hangers with double nuts.

1. Submit physical samples for approval.

E. Provide insulation protection shields: galvanized 20 gauge by 10” long for all insulated piping where hanger is installed outside the insulation sized to suit pipe size and insulation thickness.

F. IA band is acceptable.

G. For plastic piping, tape all metal hangers, clamps, etc., prior to attachment (for plastic protection).

1. Option: Provide plastic coated hangers.

H. Provide Grinnell expansion case concrete fasteners #117 for piping 3" and over where drilling of concrete is required. Submit expansion type fasteners.

2.7 ABOVEGROUND WATER PIPING

A. Install all piping in accordance with manufacturer's published recommendations and requirements and governing water department.

B. Provide fittings, bends, offsets, flanges, etc. of approved pattern. Make branch connections from hot water risers to fixtures with appropriate joints to receive expansion stresses.

C. Provide ASTM B 88, Type L for all domestic water piping; cold, hot and hot water returns.

D. Use SilvaBrite 100 Lead-Free solder on cold water and hot water piping. Provide non-corrosive, lead-free type flux conforming to ASTM B813 washable.

E. Provide pipe manufactured by Cerro, Mueller, Anaconda, and Cambridge-Lee Industries with streamlined sweat fittings at each change in direction.

1. No bent tubing will be accepted.
2. Coordinate with drawings and this section for additional locations of water hammer arrestors.

F. Copper Press Type Fittings:

Manufactures, Copper Press Fittings:

Viega North America, 3 Alfred Circle, Bedford, MA 10730, 877- 843-4262 or Ridge Tool Co., 400 Clark Street, Elyria, OH 44036, 800-519-3456

Material:

ASTM B88 and ANSI/ASME B16.22. O-rings for copper press fittings shall be EPDM.

Press connections for domestic water copper piping ½” to 2”:

Copper press fittings and installation are to be made in strict accordance with the manufacturers installation instructions. All tubing is to be reamed and de-burred prior to the installation of the fitting. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.

All valves used within a copper press-fit piping system are to be sweat type as specified under the valve section of this specification. Provide all adaptors necessary to provide sweat ball valves all sizes.

Provide copper press fit type system on domestic water piping only for pipe sizes ½” to 2”.

2.8 WATER HAMMER ARRESTORS

A. Provide Zurn Shoktrol #Z-1700, stainless steel, J.R. Smith or Watts SS series; with adaptors, sizes as required to suit manufacturer's recommendations, PDI and ASSE Standards and job conditions. Submit drawings with detailed locations and types to be used.

B. Provide water hammer arrestors at each electric solenoid valve location, unless indicated otherwise.

C. Provide water hammer arrestors at all fixture batteries with more than two (2) fixtures, unless noted otherwise.

D. Provide stainless steel access panels at all water hammer arrestors, for ease of maintenance.

2.9 DIELECTRIC FITTINGS

A. Provide NSF/ASSI 61 approved dielectric fittings when changing from ferrous to non-ferrous piping, fittings, valves, etc.; as manufactured by Watts, LF-3000 Series.

B. Where copper or brass contact ferrous material, provide protective wrapping rubber, or sheet lead wrapped around either to avoid electrolysis.

2.10 VALVES (By domestic manufacturer)

A. The entire plumbing system shall be provided with valves located to permit easy operation, replacement and repair and to permit complete control of all systems under this heading. Throttling valves shall be of the globe type and installed in all lines where regulation or modulation of flow is required. Swing check valves shall be installed in all lines where flow may reverse from that intended.

B. Check Valves: up to 3" size Nibco S-413-B-LF Apollo or Watts.

C. Ball Valves (Watts, Apollo or Nibco):

1. 1/2" to 2" - Watts No. LF-B-6080, Apollo 77FLF full port.
2. 2-1/2" to 4" - Watts No. LF-B-6000 Apollo 77FLF Series.

D. Provide holes drilled in valve handles for valve tags.

E. Drain Cocks: Watts LF-B-6000-CC, Apollo 70LF103HC with chain and cap, 1/2 inch draw-off type with Watts #8A Vacuum Breaker.

1. Provide draw-offs at low points.

2.11 NATURAL GAS PIPING

A. Provide Schedule 40 black steel piping with black malleable fittings, for piping above slab.

B. Pitch piping for drainage; install drip and valve and plug at all low points.

C. Valves 1" to 3": Bronze body screw type ball valve, full port, Watts #B-6000 YRPV-UL.

D. Valves 1" and smaller: gas cock tee handle Rockford #141 with check pin.

E. Solenoid Valves are to be wired to control panels by Electrical Contractor.

F. Valves on gas piping are to be same manufacturer as those used on water piping, including holes in handles for valve tags.

2.12 INSULATION

A. Cold Water: 1 inch fiberglass or approved equal, low pressure pipe insulation, fire retarded with Universal (white) vapor barrier finish. Provide material by Owens-Corning, Johns-Manville or Certainteed.

B. Hot Water: Insulation similar to cold water.
1. Provide 1½” thick insulation on all pipe sizes up to 2" on all hot water piping only.

C. Hot Water, Tempered Water and Hot Water Return: Insulation type is to be similar to cold water.

1. Provide 1½” thick insulation on all pipe sizes up to 2" on all tempered water and hot water piping only.

D. Fittings and Valve Insulation:

1. Hydraulic setting combination insulating and finishing cement.
2. Molded or fabricated fitting covers of equal thickness and identical in composition to adjacent pipe insulation.

a. Zeston Premolded Fittings.

3. All materials, including vapor barrier jackets, glass cloth jackets, adhesives, etc. shall be fire-retardant.

E. Insulate all water pipe, valves and fittings, etc.

F. Reinstall existing pipe covering damaged, disturbed, or removed during the course of construction at no additional cost. Identically match existing insulation thickness.

G. Provide 1” pipe insulation with protective metal jacket for all exposed acid vent pipe risers in classroom areas.

H. Provide, at all handicapped lavatories and sinks, P-trap and angle stop assemblies "Trap-Wrap Protective Kit #500R-AM" manufactured by Brocar or Truebro Lav Guard. Abrasion resistant cover shall be smooth, with white finish and a minimum 1/8" thick cushioned foam wall insert. Provide concealed fastenings. Provide units to suit offset drains at sinks.

2.13 ACCESS PANELS

A. Provide Type "A" Milcor Style "K" or "M" access panels, Karp or Acudor; sizes as required to obtain access to concealed valves, water hammer arrestors, traps and cleanouts. Provide rated panels in rated walls. Provide stainless steel panels where located in Toilet Rooms.

B. Provide vandal proof units in all public areas.

C. Coordinate installation of access panels with the work of Division 8.

2.14 MISCELLANEOUS

A. Provide chrome escutcheons and exposed piping.

B. Provide all fixtures supported from wall with 2" x 6" wood blocking concealed, built into wall, and securely fastened. (Unless fixture supports are specified elsewhere.)

C. Provide McGuire heavy duty supplies and stops.

2.15 EQUIPMENT (Furnished by others)

A. Provide all connections with necessary wastes, traps, backflow preventers, cold and hot water, gas, supplies and stops at each piece of equipment or outlet so that each facility can be separately shut down. Provide chrome piping where exposed in finished areas.

2.16 COMPRESSED AIR PIPING

A. Type “L” copper pipe and fittings similar to water piping. Only sweat joints are to be used on compressed air piping system. Connect all air piping to existing mains.

B. Valves:

1. Similar to valves used for water piping.

   a. Locate valves as indicated.
   b. Provide new valves to replace existing in ½” CA drops.

2. Provide branch pressure reducing valves equal to Quincy Company.
3. Take care that all dirt is removed from lines prior to operation.
4. Provide ball valve and plug on all low points.
5. Provide drip leg on any trapped portion of the main. Install at low point for drainage.
6. All valves same manufacturer as water piping.

2.17 ACID WASTE AND VENT PIPING:

A. Manufacturer: SCHOTT North America, Inc.

1. Contact: 555 Taxter Road, Elmsford, NY 10523; Telephone: 800-633-4505; Fax: 914-831-2201; E-mail: info@us.schott.com; website: www.us.schott.com.
2. Single Source Responsibility: Provide components and materials specified in this section from a single manufacturer.
3. Substitution Limitations:

    a. Substitutions: In accordance with Contract Conditions.

4. Description:
5. Regulatory Requirements:

    a. In accordance with Section [01 41 00 - Regulatory Requirements].
    b. Listed with UL 723 for use in fire-rated assemblies.
    c. Listed with International Association of Plumbing and Mechanical Officials.

6. Compatibility:

    a. Ensure components and materials are compatible with specified accessories and adjacent materials.

B. Provide a complete acid waste drain and vent system, as indicated, including, but not limited to, straight lengths of glass pipe, fittings and traps, couplings, hanger supports and accessories. Protected pipe during installation and provide recommended adapter couplings to connect other piping materials.

C. Materials:

1. Glass Pipe: KIMAX Glass Drainline.

    a. Above Ground:

        1) 5 Foot (1.5 m) Pipe Lengths: 6500 Series.
        2) 10 Foot (3 m) Pipe Lengths: 6501 Series.

    b. Comply with the following standards:

        1) ASTM E438.
        2) ASTM C1053.
        3) MIL-P-22561-B.

2. Connectors: KIMAX compression type bead-to-bead (#6650) and bead-to-plain end (#6661) couplings.
    a. Outer Shell: Encapsulating stainless steel band, 300-series stainless steel.
    b. Coupling Compression Liner: Buna-N-Rubber.
    c. Seal Ring Gasket: Tetra-fluoro ethylene (TFE).
    d. Nut, Bolt: Stainless steel.

D. Pipe Fittings: Sweeps, bends, reducers, tees, cleanouts, wyes, cup sinks and traps, as provided by the piping manufacturer.

E. Hardware: Adapters, sink outlet assemblies, tailpiece assemblies, gaskets, couplings and pipe hangers, as provided by the piping manufacturer.

F. Verification of Conditions: Verify that conditions of substrates previously installed under other sections or contracts are acceptable for product installation in accordance with manufacturer's instructions prior to drain and vent piping system installation.

1. Inform Owner, Architect, Consultant of unacceptable conditions immediately upon discovery.

2. Proceed with installation only after unacceptable conditions have been remedied.
3. Ensure structure or substrate is adequate to support drain and vent piping system.
4. Coordinate installation of drain and vent piping system in accordance with manufacturer's instructions.
5. Coordinate drain and vent piping system work with work of other trades for proper time and sequence to avoid construction delays.
6. Install drain and vent piping system plumb or sloped, as indicated.
7. Accurately fit, align, securely fasten and install free from distortion or defects.

G. Protect installed product from damage during construction in accordance with Section [01 76 00 - Protecting Installed Construction].

H. Repair damage to adjacent materials caused by [insert section subject matter] installation.

I. Support horizontal piping continuously with "U" or "V" shaped channels of 18 gauge sheet metal; with sizes and hangers or as required by pipe manufacturer.

PART 3 - EXECUTION

3.1 ACID WASTE AND ACID VENT PIPING:

A. Install acid waste and vent piping in accordance with the latest published Manufacturers installation instructions and requirements.

B. Provide adequate waste from fixtures, evenly pitched and properly secured with adjustable iron hangers. Install all pipes as specified, below grade, and pitch at the rate of 1/4 inch per foot or as approved.

C. Bends and Branches:
1. Provide all necessary bends, branches, etc. Make all changes in direction, fixture connections, etc. with Y branches and 45 degree elbows; offsets on vertical lines at an angle not less than 45 degrees with the vertical, being at a less angle wherever practicable. Use long sweep bends at bottom of stacks. Use certain combination and revent fittings only upon approval, after a specific one or type is submitted for approval.

D. Cleanouts:
1. Provide cleanouts same size as pipe and where indicated and at the ends of all branches, and at each change in direction of horizontal building drain greater than 45 degrees, on waste , and in such other portions where cleanouts are required.

3.2 TRAPS AND VENTS

A. Separately trap every fixture, vent all traps.

B. Install all trap screws (brass) below water line.

3.3 JOINTS

A. Threaded Joints:

1. American National taper screw threads, with graphite and oil compound applied to the male threads or Teflon tape.

2. Provide Blue Magic for all gas piping and Select Whyte for all other piping; as manufactured by Whitlaw.

B. Alternate copper piping joints according to the following:

1. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.

C. Acid Waste Piping:

1. Install all piping and fittings in complete accordance with manufacturer’s recommendations. Do not allow masonry and/or concrete to be against piping.
2. Threading of P.V.C. piping is not allowed.

3.4 HANGERS AND ANCHORS:

A. Horizontal Piping: Support the following materials at the following maximum distance intervals:

1. Acid Waste Pipe: 5 feet.
2. Threaded Pipe: 10 feet.
3. Copper Tubing (1-1/2 inch or less): 6 feet.
4. Copper Tubing (2 inch or over): 10 feet.

3.5 WATER PIPING

A. Ream all cut tube to full inside diameter of pipe. Install all piping in accordance with manufacturer's recommendations and requirements, and local water company standards.

3.6 VALVES

A. Provide valves located as follows and as indicated:

1. At foot of all supply risers, branches to separate fixtures, cold and hot supplies.
2. Provide each fixture supply with a separate angle or straight stop, finished like the pipe it serves.
3. At the foot of each riser on the upper side of the control valve, provide a 1/2 Tee and drain cock in addition to valve.

3.7 GAS PIPING

A. Do all work in accordance with the State of Rhode Island Fuel Gas Code regulations.

B. Do all work in accordance with A.G.A. regulations and local ordinances.

3.8 INSULATION

A. Submit samples of each type of material specified herein for approval.

B. Apply insulation in strict accordance with manufacturer's recommendations.

C. Provide insulating material with a maximum thermal conductance (C Value) of 0.50, low pressure pipe.

D. Cold Water: Seal all joints and seams with white or colorless vapor adhesive.

E. Hot Water and Hot Water Return: Except fastening agent shall be outward clench staples as manufactured by Bostitch.

F. Insulate fittings, valves, etc., with Fiberglas Aerocors or approved equal, to the same thickness as the adjacent pipe insulation, and finished with the same finish.

3.9 DRAINS

A. Obtain the exact information relative to finish grades at the tops of the drain.

3.10 TESTING

A. Pressure test new piping only. Do not test any existing piping. All system leaks which occur due to testing are to be repaired at no additional cost to the Owner.

B. Test all piping and make water-or-gas-tight before insulation is applied, or before concealment.
   1. Acid Waste and Acid Vent Piping: Before the installation of any fixtures, cap the ends of the system and fill all lines with water to the roof, 10 LF head will be acceptable, and let stand until a thorough inspection has been made by Local Inspector and the Engineer.
   2. Test hot and cold water piping to a hydrostatic pressure of 125 pounds per square inch for a period of 24 hours.
   3. Sterilization of water distribution system; as soon as the water distribution system has been flushed out, sterilize the system in accordance with the requirements of the Health Department having jurisdiction or, in the absence of such, by any other method satisfactory to the Owner. Chlorine used for disinfection is to be NSF 60 certified for potable water use.
   4. Test gas piping to 25 psi of air for a period of six (6) hours for above ground installation, and 100 psi for all underground work.
   5. Test compressed air piping for 24 hours at 125#.

3.11 EQUIPMENT CONNECTIONS

A. Connect plumbing lines to all mechanical equipment and all fixtures of this and other sections of this specification. Provide necessary traps, backflow preventers, tail pieces, stops and supplies, to heating equipment and other appurtenances necessary for a complete installation. All exposed piping in finished rooms to be chrome on brass.

3.12 INSTRUCTION OF OWNER'S PERSONNEL

A. Fully instruct the Owner's representative in the complete operation, adjustment and maintenance of the entire installation as directed. Arrange with the suppliers of installed equipment and/or systems to provide the services of expert technicians to instruct owner's operating personnel in the use, care and emergency repair of equipment and/or systems. The period of instruction will be as to satisfy the Architect and/or Engineer that such instructions have accomplished their purpose.

3.13 COLOR CODING AND IDENTIFICATION

A. Conformance: American National Standards Institute Standard A13.1, "Scheme for the Identification of Piping Systems".

B. Requirements: Paint on each pipe its contents and flow direction (if flow is in both directions, use double headed arrow).

C. Locations:

1. Apply stencil adjacent to each valve.
2. Apply stencil and arrow on each branch and riser take-off.
3. Apply stencil and arrow a minimum of 25 feet apart in long continuous lines.
4. Apply stencil and arrow on lower quarters on pipes or where unobstructed from view.
5. Apply stencil and arrow at every point of entry or exit thru wall, ceiling or floor.

3.14 INSTRUCTION MANUAL

A. One month prior to the completion of all work and the final inspection of the installation by the Owner, submit for approval two copies of a complete Instruction Manual, bound in a three-ring binder, typewritten and suitably indexed, containing the following minimum data:

1. List of all equipment with manufacturer's name and model number of each item.
2. Manufacturer's literature describing each item of equipment.
3. Copy of each valve chart.
4. Parts list of each major item of equipment.

END OF SECTION

SECTION 22 00 00 - INTERIOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. SECTION INCLUDES:
1. All cold and hot water piping
2. Final connections to all equipment
3. Natural Gas piping
4. Plumbing fixtures
5. All specialty and control valves
6. Insulation
7. Acid waste and vent system
8. Coordinate with Division 1 for coordination drawing requirements.
9. Temporary connections during construction.
10. Provide each system complete and ready for use.
11. Inspect, test and approve all piping before covering or concealing. No exceptions will be made.
12. Sterilization of water lines.
13. Other items in the work covered in other sections of the specifications, as shown and specified herein.
14. Final connections to plumbing fixtures as specified herein and all laboratory equipment requiring such connection

B. Provide all manufactured items and equipment in accordance with manufacturer's recommendations. Provide all necessary specialties and accessories, including anchors and supports.

C. Examine all sections of specification and drawings for requirements affecting the work of this section, as shown and specified herein.

1.3 DEFINITIONS

A. The term "capped flush" on existing piping means cap existing lines, concealed, beyond finish wall, ceiling or floor line, so proper finish can be applied.

B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, and unheated spaces immediately below roof, spaces above ceiling, unexcavated spaces, crawl spaces, and tunnels.

C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms

D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

E. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

F. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

G. The following are industry abbreviations for plastic materials:
   1. ABS: Acrylonitrile-butadiene-styrene plastic.
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. PE: Polyethylene plastic.
   4. PVC: Polyvinyl chloride plastic

H. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

I. “Furnish and install” and “Provide” means to supply, erect, install and connect in readiness for regular operation, the particular work referred to, unless otherwise specified.

J. “Underground” shall mean pipe, conduit or equipment that is buried exterior to or within the building.

K. “Finished grade” as used herein, means the final grade elevations indicated on the drawings.

L. Piping shall mean and include pipe, fittings, hangers, and valves.

M. Tempered water shall be considered the same as hot water throughout the specifications.

1.4 SHUTDOWNS

A. Coordinate all phases of the work with Owner and do all work with the least inconvenience to the Owner.

B. Coordinate all shutdowns with Owner and do all work, etc., under Owner's approved schedule.

C. Coordinate all shutdowns with Owner and do all work, etc., under Owner's approved schedule, including requirements for overtime.

1.5 EXISTING CONDITIONS

A. Bidders are advised to visit the site and inform themselves as to the existing conditions under which this work will be performed prior to submitting prices. Failure to do so, will, in no way relieve the successful bidder from the responsibility of furnishing any materials or performing any work in accordance with the true intent and meaning of the drawings and specifications.

B. No claim for extra compensation will be recognized if difficulties are encountered which an examination of the site conditions and contract documents prior to executing the contract would have revealed.

C. This Contractor shall be responsible for ordering and furnishing the correct quantity of material required. Routing and equipment arrangements shown on the drawings are approximate only and are not warranted to be accurate.

D. Arrangements shall be made with the Owner prior to the visit for inspection of the existing buildings.

E. Prior to submitting proposal, visit job site, verify and inspect existing conditions.

F. Examine building before commencing work and make known any damaged fixtures and/or piping which exists.

G. Field verify all inverts, sizes, locations, etc. at each location, prior to starting work.

H. Do not reuse piping, unless otherwise noted.

I. Remove and dispose of all plumbing fixtures, lab, equipment, piping (sanitary, vent, acid waste, acid vent, air, gas, water), etc. cap all lines in existing walls, floors, or ceilings not to be removed, flush with floors, walls, or ceilings as specified.

J. Provide temporary lines required during construction to keep existing systems in proper working order all at no additional cost.

K. Disconnect and reconnect at new locations all equipment and or fixtures that is to be relocated and provide all necessary valves, filters, fittings, regulators, reducers, etc., as required.

L. Correct and repair any damage to fixtures and piping at no additional cost.

M. Remove and dispose of piping in way of new construction. Cap or plug, as required.

N. Relocate piping, to remain, in way of new construction at no additional cost.

1.6 RELATED SECTIONS

A. Cutting and patching - Division 1.

B. Coring of holes and saw cutting in concrete and all X-ray work - Division 1.

C. Fire-stopping – Division 7.

D. Access panels - Division 8.

E. Field painting of piping, hangers, etc. - Division 9.

F. Chilled water supply and return piping - Division 23.

G. Condensate piping - Division 23.

H. Heating connections, thermostats - Division 23.

I. Electrical connections - Division 26.

1.7 CODES, ORDINANCES AND PERMITS

A. Obtain all necessary permits and pay resultant fees. Provide copy of application to owner and architect.

B. All work performed under this section of the specifications shall be done in accordance with the applicable National, State of Rhode Island Plumbing and Energy Codes and local codes, laws and ordinances and State of Rhode Island Fuel Gas and Energy Codes.

C. All materials and work provided shall be in accordance with, but not limited to, the following:

1. American National Standards Institute (ANSI).
2. American Society for Testing and Materials (ASTM)
3. Building Officials and Code Administrators (BOCA)
4. National and State Electrical Code (NEC)
5. National Electrical Manufacturer's Association (NEMA
6. National Fire Protection Association Codes and Standards (NFPA)
7. Occupational Safety and Health Act (OSHA)
8. State Building and Handicapped Codes
9. Standards of Underwriters Laboratories (UL)
10. Warwick Sewer Authority Rules and Regulations

D. Where code references are given, the latest issue of that code in effect at the time of bidding shall be used. Code references given to indicate the minimum quality and performance acceptable. Where specifications and/or drawings indicate more stringent requirements, the specification shall govern.

E. Permits: Be responsible for filing all documents, payment of all fees and securing of all inspections and approvals necessary for the installation and operation of all systems furnished under this section.

1.8 PROTECTION

A. Protect materials, fixtures and fittings. Temporarily close all pipe openings to prevent obstruction and damage. Board over, water closets, lavatories and sinks and protect other fixtures with pasted-on paper.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

C. Post notices prohibiting the use of the fixtures prior to completion.

1.9 CUTTING AND FITTING

A. Do the cutting and fitting necessary for the installation of the plumbing work and maintain fire integrity of floor to floor construction.

B. Take care to prevent injury, discoloration or defacement of other finish materials; and do no cutting or fitting of finish material.

1.10 CLEANING

A. Upon completion of the installation, clean and remove all oil and debris. Clean and polish and leave bright all fixtures and metal work intended to be exposed. Clean out the piping systems and all fixtures, traps and cleanouts. Leave all work in perfect operating condition.

B. Should any pipe, duct or any part of the apparatus be stopped by refuse after the apparatus has been accepted, pay for the disconnecting, cleaning and reconnection, wherever necessary, for the purpose of location and removing the obstruction. Pay for repairs to adjoining work required thereby.

1.11 DRAWINGS

A. The drawings are diagrammatic, and not intended to show every detail of construction or arbitrary location of piping. Where building construction makes it advisable or necessary to change location of piping or fixtures, without increasing the scope of work, perform such work without additional cost, on written order or consent of the Engineer.

B. Install the work as shown. In case of conflict with building parts, or the work of other trades, immediately request a decision be rendered so that there may be no delay in the building construction.

C. Submit for written approval, single line diagrams of any proposed changes or modification to the drawings, at least one week before prices are due.

1.12 QUALITY ASSURANCE

A. Submit catalog cuts and brochures for approval of all proposed materials to be used on the project.

B. Materials and equipment under the section shall be new and of the best grade.
   1. Materials shall conform to the requirement of the State of Rhode Island Plumbing Code, local city requirements, and standards listed such as commercial USAS or ASTM and requirements specifically stipulated herein.

C. All plumbing products used within the domestic water system are to meet or exceed NSF/ANSI 61 Standard requirements for lead-free products.

D. Unless otherwise specified, apply and pay for all necessary permits, fees, and inspections required by any public authority having jurisdiction.

E. Submit copies of manufacturer's recommendation on installing pipe for approval.

F. In addition to other requirements specified herein, the Contractor shall furnish notarized test reports and methods of test by an approved independent testing laboratory to show compliance of all materials furnished under this section of the specifications with all specification requirements and pipe manufacturer's notarized certificates of conformance stating that all materials to be furnished under these items conform with all specification requirements. Each shipment of pipe and pipe fittings shall be accompanied with the pipe manufacturer's notarized certificate of conformance, certifying that the pipe and pipe fittings meet all requirements of the specifications. All testing of all materials furnished under this section of the specifications shall be provided by the Contractor at no additional expense to the Owner.

G. Where items of equipment and/or materials are specified or materials are specified or identified herein by manufacturer's names, model or catalog numbers, only such specified items may be used.

H. Submit, in booklet form, all plumbing fixtures and related accessories for any fixtures and/or equipment different than the manufacturers listed. Submit catalog cuts of both manufacturers.

I. Submit complete maintenance and operational charts and manuals for all equipment and fixtures specified, indicated or required for this work.

J. On completion of the work, attach 1-1/2" diameter brass or embossed plastic as manufactured by Seton Nameplate Company consecutively numbered tags to all valves, also furnish two (2) typewritten charts (framed and glazed) showing all valve numbers with their location and riser controls. Identify all equipment with laminated plastic (lamicoid) nameplates fastened to the equipment as approved. These numbered valves to be shown on Record Drawings.

K. Keep on file, at job site, a clean set of prints to clearly and accurately note all changes, wherever work is installed other than shown. After completion of work, provide a corrected set of drawings in PDF format on CD labeled "Record Drawings" and (2) sets of prints.

1.13 ACCESSIBILITY

A. Be responsible for sufficiency of shafts and chases, with adequate clearances for the proper installation of the work. Cooperate with all other contractors, whose work is in the same space, and advise the Contractor of all requirements. Keep such spaces and clearances to the minimum size required.

B. Locate all equipment, which must be operated, serviced or maintained, in fully accessible locations. Equipment includes, but is not limited to: valves, traps, cleanouts and drain points. If required for better accessibility, provide access doors. Make minor deviations to allow for better accessibility, however, review such changes with the Architect/Engineer.

1.14 COORDINATION

A. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.15 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

A. Refer to General Conditions (and Supplementary Conditions), Shop Drawings, Product Data and Samples and add the following:
   1. Within thirty (30) days after the date of notice to proceed and before purchasing any materials or equipment, submit to the Architect for review, a complete list, in six (6) copies, of all materials to be incorporated in the work. This listing shall be arranged by the order of occurrence in the specifications, followed by the items on the drawings not specifically included in the specifications.
   2. After the list has been processed by the Architect, submit complete shop drawings and product data of all equipment. These submittals shall be submitted within thirty (30) days after the processing date of the original submittal list.
   3. All submittals shall be complete and shall be in three-ring loose-leaf binders. No consideration will be given to partial submittals, except with prior approval of the Architect. Each item shall have a cover page stating project, specification and paragraph reference number, of drawing reference number, and scheduled equipment identification number, if applicable.
   4. The review of submittals does not relieve this Contractor from the responsibility of shop drawing errors in details, sizes, quantities, wiring diagram arrangements and dimensions which deviate from the specifications, contract drawings, and/or job conditions as they exist.
   5. Changes to work already performed made necessary by delays in shop drawing review are the responsibility of this Contractor.
   6. Copies of equipment and system guarantees shall be submitted with shop drawing package.

B. Refer to General Conditions (and Supplementary Conditions) for substitution of equipment.

C. If apparatus or materials are substituted for those specified under this section, and such substitutions necessitate changes in or additional connects, supports or construction, same shall be provided at no additional cost to the Owner. This Contractor shall assume cost and entire responsibility thereof. Architect's permission to make such substitution shall not relieve this Contractor from full responsibility for work.

1.16 RECORD DRAWING

A. The General Contractor shall provide two (2) sets of black line on white record drawings to this Contractor, one set of which shall be maintained at the site and one set of which shall, at all times, be accurate, clear and complete, showing the actual location of all equipment and piping. The record drawings shall be available to the Architect's/Engineer's field representative at all times.

B. Any addenda sketches, supplementary drawings and change orders issued during the course of construction shall be transferred to the record drawings.

C. At the completion of this contract, this Contractor shall submit through the General Contractor an accurate checked set of record drawings.

D. Non-availability of record drawings or inaccuracies therein shall postpone the final inspection until they are available.

E. After approval of these record drawings, photo reproductions of the original tracings shall be revised to incorporate all the changes on the record drawings. These photo reproductions shall be certified by this Contractor as correct and delivered to the Architect together with two (2) sets of black line prints.

F. All costs related to the foregoing requirements shall be paid for this Contractor.

G. All valves shown on these drawings shall be numbered with numbers corresponding to those on the valve charts.

1.17 USE OF ELECTRONIC DRAWING FILES

A. If requested, the Engineer will provide electronic copies of selected CAD (Computer Aided Design) drawing files for the Contractor's use in the preparation of shop drawings, coordination drawings, or as-built drawings related to this project, subject to the terms and conditions in the following paragraphs.

B. The Engineer's electronic files are prepared on AutoCAD. The Engineer will provide drawing files through Release 2008.

C. Data contained on these electronic files is part of the Engineer's instruments of service and shall not be used by the Contractor or anyone else receiving this data through or from the Contractor for any purpose other than as a convenience in the preparation of shop drawings, coordination drawings, or as-built drawings for the referenced project. Any other use or reuse by the Contractor or by others will be at the Contractor's sole risk and without liability or legal exposure to the Engineer. In accepting these files, the Contractor shall agree to make no claim and shall waive, to the fullest extent permitted by law, any claim or cause of action of any nature against the Engineer, its officers, directors, and employees, agents of the Engineer, which may arise out of or in connection with the Contractor's use of the electronic files.

D. Furthermore, the Contractor shall to the fullest extent permitted by law, indemnify and hold harmless the Engineer from all claims, damages, losses and expenses, including attorney's fees arising out of or resulting from the Contractor's use of these electronic files.

E. These electronic files are not contract documents. Significant differences may exist between these electronic files and corresponding hard copy contract documents due to software incompatibility, software translation, addenda, change orders or other revisions. The engineer makes no representation regarding the accuracy or completeness of these electronic files. In the event that a conflict arises

between the hard copy contract documents prepared by the Engineer and the electronic files, the hard copy contract documents shall govern. The Contractor is responsible for determining if any conflict exists.

1. By use of these electronic files, the Contractor is not relieved of his duty to fully comply with the contract documents, including and without limitation, the need to check, confirm and coordinate all work with that of other contractors for the project.

F. Because of the potential that the information presented on the electronic files can be modified, unintentionally or otherwise, the Engineer reserves the right to remove all indication of their respective ownership and/or involvement form each electronic file provided.

G. Under no circumstances shall delivery of the electronic files for use by the Contractor be deemed a sale by the Engineer, who makes no warranties, either expressed or implied, of merchantability and fitness for any particular purpose. In no event shall the Engineer or its consultant (s) be liable for any loss of profit or any consequential damages arising out of the use of these electronic files.

1.18 WARRANTY

A. Refer to General Conditions and add the following:

1. Standard equipment guarantees offered by the manufacturer for on (1) year or greater shall be in addition to that as required by this contract.
2. Copy of manufacturer's equipment guarantees shall be submitted with this Contractor's written guarantee.

PART 2 - PRODUCTS

2.1 INDIRECT WASTE PIPING

A. Type L copper with copper DWV sweat fittings.

B. Plastic pipe, Schedule 40, DWV (ASTM D-1785 and ASTM D-2665), unless indicated otherwise.

2.2 CLEANOUTS

A. Provide raised square head cleanout plugs, where possible.

B. Provide Zurn ZN-1447-BP-VP for all areas where wall thickness is insufficient to install stainless steel or steel access doors, vandal proof, bronze plug.

2.3 WASTE AND VENT PIPING:

A. Aboveground Piping: (unless otherwise indicated)

1. Solid plastic piping, PVC Schedule 40 DWV, Iron pipe Sizes (IPS) conforming to ASTM D-1785 and ASTM D-2665. PVC DWV solvent cement fittings are to conform to ASTM D-2665. Pipe and fittings are to be manufactured to the nominal dimensions cited in the applicable ASTM standard, and to be manufactured by one manufacturer.

2. Foam core PVC piping is not allowed on this project. All foam core piping installed on project is to be removed and replace at no additional cost to owner.

3. Provide chrome plating for all exposed piping to plumbing fixtures in classrooms, and finished rooms, etc., including chrome plated traps.

4. Chrome plate all exposed traps and water supplies, whether insulated or not, including piping covered with Trap-Wrap.

2.4 TRAPS

A. Provide standard N.Y. Reg. "P" traps.

B. All fixtures with waste connections shall be properly trapped and vented in accordance with the requirements of the State Plumbing Code and Plumbing Inspector.

2.5 SLEEVES, INSERTS AND ESCUTCHEONS

A. For all openings required in concrete floors, concrete walls and masonry walls; install sleeves of proper size, or masonry is set. Provide wrought iron and steel pipe sleeves for all sleeves through floors or walls, sizes as approved, and packed as required. Extend sleeves one inch above floor for exposed piping passing through the floor.

B. Fit all exposed uncovered pipes passing through walls, in cabinets, floors and ceilings with chromium plated spun or split type escutcheons with clamping device for holding in position.

C. Typical for all piping.

D. This contractor is to verify that all fire stopping is compatible with each piping system.

E. Coordinate all sleeving requirements with fire stopping contractor.

F. Coordinate with Fire Stopping contractor all sleeving material types and sleeve sizes to conform to the appropriate U.L. fire-stopping details per the hourly requirements specified in Division 7. Sleeving is required for all piping through floors, walls install sleeves in accordance with manufacturer's printed instructions.

2.6 HANGERS AND ANCHORS

A. Support all piping from the building structure by means of approved hangers and cast iron concrete inserts or lag bolts. Support piping to maintain required grading and pitching of lines, to prevent vibration and to secure piping in place, and arrange so as to provide for expansion and contraction. Provide approved anchors.

B. Provide all acid, waste, vent stacks and other pipe risers with friction clamp at each floor level and where required.

C. Provide clevis ring type hangers for piping with adjustable device, and machine threaded hanger rods. Provide copperized hangers for water piping. Size of rods shall follow schedule in NFPA Bulletin No. 13.

D. Provide hangers with double nuts.

1. Submit physical samples for approval.

E. Provide insulation protection shields: galvanized 20 gauge by 10” long for all insulated piping where hanger is installed outside the insulation sized to suit pipe size and insulation thickness.

F. IA band is acceptable.

G. For plastic piping, tape all metal hangers, clamps, etc., prior to attachment (for plastic protection).

   1. Option: Provide plastic coated hangers.

H. Provide Grinnell expansion case concrete fasteners #117 for piping 3" and over where drilling of concrete is required. Submit expansion type fasteners.

2.7 ABOVEGROUND WATER PIPING

A. Install all piping in accordance with manufacturer's published recommendations and requirements and governing water department.

B. Provide fittings, bends, offsets, flanges, etc. of approved pattern. Make branch connections from hot water risers to fixtures with appropriate joints to receive expansion stresses.

C. Provide ASTM B 88, Type L for all domestic water piping; cold, hot and hot water returns.

D. Use SilvaBrite 100 Lead-Free solder on cold water and hot water piping. Provide non-corrosive, lead-free type flux conforming to ASTM B813 washable.

E. Provide pipe manufactured by Cerro, Mueller, Anaconda, and Cambridge-Lee Industries with streamlined sweat fittings at each change in direction.

   1. No bent tubing will be accepted.
   2. Coordinate with drawings and this section for additional locations of water hammer arrestors.

F. Copper Press Type Fittings:

   Manufactures, Copper Press Fittings:

   Viega North America, 3 Alfred Circle, Bedford, MA 10730, 877- 843-4262 or Ridge Tool Co., 400 Clark Street, Elyria, OH 44036, 800-519-3456

   Material:

   ASTM B88 and ANSI/ASME B16.22. O-rings for copper press fittings shall be EPDM.

   Press connections for domestic water copper piping ½” to 2”:

   Copper press fittings and installation are to be made in strict accordance with the manufacturers installation instructions. All tubing is to be reamed and de-burred prior to the installation of the fitting. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.

   All valves used within a copper press-fit piping system are to be sweat type as specified under the valve section of this specification. Provide all adaptors necessary to provide sweat ball valves all sizes.

   Provide copper press fit type system on domestic water piping only for pipe sizes ½” to 2”.

2.8 WATER HAMMER ARRESTORS

A. Provide Zurn Shoktrol #Z-1700, stainless steel, J.R. Smith or Watts SS series; with adaptors, sizes as required to suit manufacturer's recommendations, PDI and ASSE Standards and job conditions. Submit drawings with detailed locations and types to be used.

B. Provide water hammer arrestors at each electric solenoid valve location, unless indicated otherwise.

C. Provide water hammer arrestors at all fixture batteries with more than two (2) fixtures, unless noted otherwise.

D. Provide stainless steel access panels at all water hammer arrestors, for ease of maintenance.

2.9 DIELECTRIC FITTINGS

A. Provide NSF/ASSI 61 approved dielectric fittings when changing from ferrous to non-ferrous piping, fittings, valves, etc.; as manufactured by Watts, LF-3000 Series.

B. Where copper or brass contact ferrous material, provide protective wrapping rubber, or sheet lead wrapped around either to avoid electrolysis.

2.10 VALVES (By domestic manufacturer)

A. The entire plumbing system shall be provided with valves located to permit easy operation, replacement and repair and to permit complete control of all systems under this heading. Throttling valves shall be of the globe type and installed in all lines where regulation or modulation of flow is required. Swing check valves shall be installed in all lines where flow may reverse from that intended.

B. Check Valves: up to 3" size Nibco S-413-B-LF Apollo or Watts.

C. Ball Valves (Watts, Apollo or Nibco):

1. 1/2" to 2" - Watts No. LF-B-6080, Apollo 77FLF full port.
2. 2-1/2" to 4" - Watts No. LF-B-6000 Apollo 77FLF Series.

D. Provide holes drilled in valve handles for valve tags.

E. Drain Cocks: Watts LF-B-6000-CC, Apollo 70LF103HC with chain and cap, 1/2 inch draw-off type with Watts #8A Vacuum Breaker.

1. Provide draw-offs at low points.

2.11 NATURAL GAS PIPING

A. Provide Schedule 40 black steel piping with black malleable fittings, for piping above slab.

B. Pitch piping for drainage; install drip and valve and plug at all low points.

C. Valves 1" to 3": Bronze body screw type ball valve, full port, Watts #B-6000 YRPV-UL.

D. Valves 1" and smaller: gas cock tee handle Rockford #141 with check pin.

E. Solenoid Valves are to be wired to control panels by Electrical Contractor.

F. Valves on gas piping are to be same manufacturer as those used on water piping, including holes in handles for valve tags.

2.12 INSULATION

A. Cold Water: 1 inch fiberglass or approved equal, low pressure pipe insulation, fire retarded with Universal (white) vapor barrier finish. Provide material by Owens-Corning, Johns-Manville or Certainteed.

B. Hot Water: Insulation similar to cold water.
   1. Provide 1½” thick insulation on all pipe sizes up to 2" on all hot water piping only.

C. Hot Water, Tempered Water and Hot Water Return: Insulation type is to be similar to cold water.

   1. Provide 1½” thick insulation on all pipe sizes up to 2" on all tempered water and hot water piping only.

D. Fittings and Valve Insulation:

   1. Hydraulic setting combination insulating and finishing cement.
   2. Molded or fabricated fitting covers of equal thickness and identical in composition to adjacent pipe insulation.

      a. Zeston Premolded Fittings.

   3. All materials, including vapor barrier jackets, glass cloth jackets, adhesives, etc. shall be fire-retardant.

E. Insulate all water pipe, valves and fittings, etc.

F. Reinstall existing pipe covering damaged, disturbed, or removed during the course of construction at no additional cost. Identically match existing insulation thickness.

G. Provide 1” pipe insulation with protective metal jacket for all exposed acid vent pipe risers in classroom areas.

H. Provide, at all handicapped lavatories and sinks, P-trap and angle stop assemblies "Trap-Wrap Protective Kit #500R-AM" manufactured by Brocar or Truebro Lav Guard. Abrasion resistant cover shall be smooth, with white finish and a minimum 1/8" thick cushioned foam wall insert. Provide concealed fastenings. Provide units to suit offset drains at sinks.

2.13 ACCESS PANELS

A. Provide Type "A" Milcor Style "K" or "M" access panels, Karp or Acudor; sizes as required to obtain access to concealed valves, water hammer arrestors, traps and cleanouts. Provide rated panels in rated walls. Provide stainless steel panels where located in Toilet Rooms.

B. Provide vandal proof units in all public areas.

C. Coordinate installation of access panels with the work of Division 8.

2.14 MISCELLANEOUS

A. Provide chrome escutcheons and exposed piping.

B. Provide all fixtures supported from wall with 2" x 6" wood blocking concealed, built into wall, and securely fastened. (Unless fixture supports are specified elsewhere.)

C. Provide McGuire heavy duty supplies and stops.

2.15 EQUIPMENT (Furnished by others)

A. Provide all connections with necessary wastes, traps, backflow preventers, cold and hot water, gas, supplies and stops at each piece of equipment or outlet so that each facility can be separately shut down. Provide chrome piping where exposed in finished areas.

2.16 COMPRESSED AIR PIPING

A. Type “L” copper pipe and fittings similar to water piping. Only sweat joints are to be used on compressed air piping system. Connect all air piping to existing mains.

B. Valves:

1. Similar to valves used for water piping.

   a. Locate valves as indicated.
   b. Provide new valves to replace existing in ½” CA drops.

2. Provide branch pressure reducing valves equal to Quincy Company.
3. Take care that all dirt is removed from lines prior to operation.
4. Provide ball valve and plug on all low points.
5. Provide drip leg on any trapped portion of the main. Install at low point for drainage.
6. All valves same manufacturer as water piping.

2.17 ACID WASTE AND VENT PIPING:

A. Manufacturer: SCHOTT North America, Inc.

1. Contact: 555 Taxter Road, Elmsford, NY 10523; Telephone: 800-633-4505; Fax: 914-831-2201; E-mail: info@us.schott.com; website: www.us.schott.com.
2. Single Source Responsibility: Provide components and materials specified in this section from a single manufacturer.
3. Substitution Limitations:

   a. Substitutions: In accordance with Contract Conditions.

4. Description:
5. Regulatory Requirements:

   a. In accordance with Section [01 41 00 - Regulatory Requirements].
   b. Listed with UL 723 for use in fire-rated assemblies.
   c. Listed with International Association of Plumbing and Mechanical Officials.

6. Compatibility:

   a. Ensure components and materials are compatible with specified accessories and adjacent materials.

B. Provide a complete acid waste drain and vent system, as indicated, including, but not limited to,

straight lengths of glass pipe, fittings and traps, couplings, hanger supports and accessories. Protected pipe during installation and provide recommended adapter couplings to connect other piping materials.

C. Materials:

1. Glass Pipe: KIMAX Glass Drainline.
   a. Above Ground:
      1) 5 Foot (1.5 m) Pipe Lengths: 6500 Series.
      2) 10 Foot (3 m) Pipe Lengths: 6501 Series.
   b. Comply with the following standards:
      1) ASTM E438.
      2) ASTM C1053.
      3) MIL-P-22561-B.
2. Connectors: KIMAX compression type bead-to-bead (#6650) and bead-to-plain end (#6661) couplings.
   a. Outer Shell: Encapsulating stainless steel band, 300-series stainless steel.
   b. Coupling Compression Liner: Buna-N-Rubber.
   c. Seal Ring Gasket: Tetra-fluoro ethylene (TFE).
   d. Nut, Bolt: Stainless steel.

D. Pipe Fittings: Sweeps, bends, reducers, tees, cleanouts, wyes, cup sinks and traps, as provided by the piping manufacturer.

E. Hardware: Adapters, sink outlet assemblies, tailpiece assemblies, gaskets, couplings and pipe hangers, as provided by the piping manufacturer.

F. Verification of Conditions: Verify that conditions of substrates previously installed under other sections or contracts are acceptable for product installation in accordance with manufacturer's instructions prior to drain and vent piping system installation.

1. Inform Owner, Architect, Consultant of unacceptable conditions immediately upon discovery.
2. Proceed with installation only after unacceptable conditions have been remedied.
3. Ensure structure or substrate is adequate to support drain and vent piping system.
4. Coordinate installation of drain and vent piping system in accordance with manufacturer’s instructions.
5. Coordinate drain and vent piping system work with work of other trades for proper time and sequence to avoid construction delays.
6. Install drain and vent piping system plumb or sloped, as indicated.
7. Accurately fit, align, securely fasten and install free from distortion or defects.

G. Protect installed product from damage during construction in accordance with Section [01 76 00 - Protecting Installed Construction].

H. Repair damage to adjacent materials caused by [insert section subject matter] installation.

I. Support horizontal piping continuously with "U" or "V" shaped channels of 18 gauge sheet metal; with sizes and hangers or as required by pipe manufacturer.

PART 3 - EXECUTION

3.1 ACID WASTE AND ACID VENT PIPING:

A. Install acid waste and vent piping in accordance with the latest published Manufacturers installation instructions and requirements.

B. Provide adequate waste from fixtures, evenly pitched and properly secured with adjustable iron hangers. Install all pipes as specified, below grade, and pitch at the rate of 1/4 inch per foot or as approved.

C. Bends and Branches:
   1. Provide all necessary bends, branches, etc. Make all changes in direction, fixture connections, etc. with Y branches and 45 degree elbows; offsets on vertical lines at an angle not less than 45 degrees with the vertical, being at a less angle wherever practicable. Use long sweep bends at bottom of stacks. Use certain combination and revent fittings only upon approval, after a specific one or type is submitted for approval.

D. Cleanouts:
   1. Provide cleanouts same size as pipe and where indicated and at the ends of all branches, and at each change in direction of horizontal building drain greater than 45 degrees, on waste , and in such other portions where cleanouts are required.

3.2 TRAPS AND VENTS

A. Separately trap every fixture, vent all traps.

B. Install all trap screws (brass) below water line.

3.3 JOINTS

A. Threaded Joints:

   1. American National taper screw threads, with graphite and oil compound applied to the male threads or Teflon tape.
   2. Provide Blue Magic for all gas piping and Select Whyte for all other piping; as manufactured by Whitlaw.

B. Copper piping joints according to the following:

   1. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.

C. Acid Waste Piping:

   1. Install all piping and fittings in complete accordance with manufacturer’s recommendations. Do not allow masonry and/or concrete to be against piping.
   2. Threading of P.V.C. piping is not allowed.

3.4 HANGERS AND ANCHORS:

A. Horizontal Piping: Support the following materials at the following maximum distance intervals:

   1. Acid Waste Pipe: 5 feet.
   2. Threaded Pipe: 10 feet.
   3. Copper Tubing (1-1/2 inch or less): 6 feet.

4. Copper Tubing (2 inch or over): 10 feet.

3.5 WATER PIPING

A. Ream all cut tube to full inside diameter of pipe. Install all piping in accordance with manufacturer's recommendations and requirements, and local water company standards.

3.6 VALVES

A. Provide valves located as follows and as indicated:

1. At foot of all supply risers, branches to separate fixtures, cold and hot supplies.
2. Provide each fixture supply with a separate angle or straight stop, finished like the pipe it serves.
3. At the foot of each riser on the upper side of the control valve, provide a 1/2 Tee and drain cock in addition to valve.

3.7 GAS PIPING

A. Do all work in accordance with the State of Rhode Island Fuel Gas Code regulations.

B. Do all work in accordance with A.G.A. regulations and local ordinances.

3.8 INSULATION

A. Submit samples of each type of material specified herein for approval.

B. Apply insulation in strict accordance with manufacturer's recommendations.

C. Provide insulating material with a maximum thermal conductance (C Value) of 0.50, low pressure pipe.

D. Cold Water: Seal all joints and seams with white or colorless vapor adhesive.

E. Hot Water and Hot Water Return: Except fastening agent shall be outward clench staples as manufactured by Bostitch.

F. Insulate fittings, valves, etc., with Fiberglas Aerocors or approved equal, to the same thickness as the adjacent pipe insulation, and finished with the same finish.

3.9 DRAINS

A. Obtain the exact information relative to finish grades at the tops of the drain.

3.10 TESTING

A. Pressure test new piping only. Do not test any existing piping. All system leaks which occur due to testing are to be repaired at no additional cost to the Owner.

B. Test all piping and make water-or-gas-tight before insulation is applied, or before concealment.
1. Acid Waste and Acid Vent Piping: Before the installation of any fixtures, cap the ends of the system and fill all lines with water to the roof, 10 LF head will be acceptable, and let stand until a thorough inspection has been made by Local Inspector and the Engineer.

2. Test hot and cold water piping to a hydrostatic pressure of 125 pounds per square inch for a period of 24 hours.
3. Sterilization of water distribution system; as soon as the water distribution system has been flushed out, sterilize the system in accordance with the requirements of the Health Department having jurisdiction or, in the absence of such, by any other method satisfactory to the Owner. Chlorine used for disinfection is to be NSF 60 certified for potable water use.
4. Test gas piping to 25 psi of air for a period of six (6) hours for above ground installation, and 100 psi for all underground work.
5. Test compressed air piping for 24 hours at 125#.

3.11 EQUIPMENT CONNECTIONS

A. Connect plumbing lines to all mechanical equipment and all fixtures of this and other sections of this specification. Provide necessary traps, backflow preventers, tail pieces, stops and supplies, to heating equipment and other appurtenances necessary for a complete installation. All exposed piping in finished rooms to be chrome on brass.

3.12 INSTRUCTION OF OWNER'S PERSONNEL

A. Fully instruct the Owner's representative in the complete operation, adjustment and maintenance of the entire installation as directed. Arrange with the suppliers of installed equipment and/or systems to provide the services of expert technicians to instruct owner's operating personnel in the use, care and emergency repair of equipment and/or systems. The period of instruction will be as to satisfy the Architect and/or Engineer that such instructions have accomplished their purpose.

3.13 COLOR CODING AND IDENTIFICATION

A. Conformance: American National Standards Institute Standard A13.1, "Scheme for the Identification of Piping Systems".

B. Requirements: Paint on each pipe its contents and flow direction (if flow is in both directions, use double headed arrow).

C. Locations:

1. Apply stencil adjacent to each valve.
2. Apply stencil and arrow on each branch and riser take-off.
3. Apply stencil and arrow a minimum of 25 feet apart in long continuous lines.
4. Apply stencil and arrow on lower quarters on pipes or where unobstructed from view.
5. Apply stencil and arrow at every point of entry or exit thru wall, ceiling or floor.

3.14 INSTRUCTION MANUAL

A. One month prior to the completion of all work and the final inspection of the installation by the Owner, submit for approval two copies of a complete Instruction Manual, bound in a three-ring binder, typewritten and suitably indexed, containing the following minimum data:

1. List of all equipment with manufacturer's name and model number of each item.
2. Manufacturer's literature describing each item of equipment.
3. Copy of each valve chart.
4. Parts list of each major item of equipment.

END OF SECTION

SECTION 22 00 00 - INTERIOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. SECTION INCLUDES:
1. All cold and hot water piping
2. Final connections to all equipment
3. Natural Gas piping
4. Plumbing fixtures
5. All specialty and control valves
6. Insulation
7. Acid waste and vent system
8. Coordinate with Division 1 for coordination drawing requirements.
9. Temporary connections during construction.
10. Provide each system complete and ready for use.
11. Inspect, test and approve all piping before covering or concealing. No exceptions will be made.
12. Sterilization of water lines.
13. Other items in the work covered in other sections of the specifications, as shown and specified herein.
14. Final connections to plumbing fixtures as specified herein and all laboratory equipment requiring such connection

B. Provide all manufactured items and equipment in accordance with manufacturer's recommendations. Provide all necessary specialties and accessories, including anchors and supports.

C. Examine all sections of specification and drawings for requirements affecting the work of this section, as shown and specified herein.

1.3 DEFINITIONS

A. The term "capped flush" on existing piping means cap existing lines, concealed, beyond finish wall, ceiling or floor line, so proper finish can be applied.

B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, and unheated spaces immediately below roof, spaces above ceiling, unexcavated spaces, crawl spaces, and tunnels.

C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms

D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

E. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

F. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

G. The following are industry abbreviations for plastic materials:
   1. ABS: Acrylonitrile-butadiene-styrene plastic.
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. PE: Polyethylene plastic.
   4. PVC: Polyvinyl chloride plastic

H. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

I. “Furnish and install” and “Provide” means to supply, erect, install and connect in readiness for regular operation, the particular work referred to, unless otherwise specified.

J. “Underground” shall mean pipe, conduit or equipment that is buried exterior to or within the building.

K. “Finished grade” as used herein, means the final grade elevations indicated on the drawings.

L. Piping shall mean and include pipe, fittings, hangers, and valves.

M. Tempered water shall be considered the same as hot water throughout the specifications.

1.4 SHUTDOWNS

A. Coordinate all phases of the work with Owner and do all work with the least inconvenience to the Owner.

B. Coordinate all shutdowns with Owner and do all work, etc., under Owner's approved schedule.

C. Coordinate all shutdowns with Owner and do all work, etc., under Owner's approved schedule, including requirements for overtime.

1.5 EXISTING CONDITIONS

A. Bidders are advised to visit the site and inform themselves as to the existing conditions under which this work will be performed prior to submitting prices. Failure to do so, will, in no way relieve the successful bidder from the responsibility of furnishing any materials or performing any work in accordance with the true intent and meaning of the drawings and specifications.

B. No claim for extra compensation will be recognized if difficulties are encountered which an examination of the site conditions and contract documents prior to executing the contract would have revealed.

C. This Contractor shall be responsible for ordering and furnishing the correct quantity of material required. Routing and equipment arrangements shown on the drawings are approximate only and are not warranted to be accurate.

D. Arrangements shall be made with the Owner prior to the visit for inspection of the existing buildings.

E. Prior to submitting proposal, visit job site, verify and inspect existing conditions.

F. Examine building before commencing work and make known any damaged fixtures and/or piping which exists.

G. Field verify all inverts, sizes, locations, etc. at each location, prior to starting work.

H. Do not reuse piping, unless otherwise noted.

I. Remove and dispose of all plumbing fixtures, lab, equipment, piping (sanitary, vent, acid waste, acid vent, air, gas, water), etc. cap all lines in existing walls, floors, or ceilings not to be removed, flush with floors, walls, or ceilings as specified.

J. Provide temporary lines required during construction to keep existing systems in proper working order all at no additional cost.

K. Disconnect and reconnect at new locations all equipment and or fixtures that is to be relocated and provide all necessary valves, filters, fittings, regulators, reducers, etc., as required.

L. Correct and repair any damage to fixtures and piping at no additional cost.

M. Remove and dispose of piping in way of new construction. Cap or plug, as required.

N. Relocate piping, to remain, in way of new construction at no additional cost.

1.6 RELATED SECTIONS

A. Cutting and patching - Division 1.

B. Coring of holes and saw cutting in concrete and all X-ray work - Division 1.

C. .

D. Fire-stopping – Division 7.

E. Access panels - Division 8.

F. Field painting of piping, hangers, etc. - Division 9.

G. Chilled water supply and return piping - Division 23.

H. Condensate piping - Division 23.

I. Heating connections, thermostats - Division 23.

J. Electrical connections - Division 26.

1.7 CODES, ORDINANCES AND PERMITS

A. Obtain all necessary permits and pay resultant fees. Provide copy of application to owner and architect.

B. All work performed under this section of the specifications shall be done in accordance with the applicable National, State of Rhode Island Plumbing and Energy Codes and local codes, laws and ordinances and State of Rhode Island Fuel Gas and Energy Codes.

C. All materials and work provided shall be in accordance with, but not limited to, the following:
   1. American National Standards Institute (ANSI).
   2. American Society for Testing and Materials (ASTM)
   3. Building Officials and Code Administrators (BOCA)
   4. National and State Electrical Code (NEC)
   5. National Electrical Manufacturer's Association (NEMA
   6. National Fire Protection Association Codes and Standards (NFPA)
   7. Occupational Safety and Health Act (OSHA)
   8. State Building and Handicapped Codes
   9. Standards of Underwriters Laboratories (UL)
   10. Warwick Sewer Authority Rules and Regulations

D. Where code references are given, the latest issue of that code in effect at the time of bidding shall be used. Code references given to indicate the minimum quality and performance acceptable. Where specifications and/or drawings indicate more stringent requirements, the specification shall govern.

E. Permits: Be responsible for filing all documents, payment of all fees and securing of all inspections and approvals necessary for the installation and operation of all systems furnished under this section.

1.8 PROTECTION

A. Protect materials, fixtures and fittings. Temporarily close all pipe openings to prevent obstruction and damage. Board over, water closets, lavatories and sinks and protect other fixtures with pasted-on paper.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

C. Post notices prohibiting the use of the fixtures prior to completion.

1.9 CUTTING AND FITTING

A. Do the cutting and fitting necessary for the installation of the plumbing work and maintain fire integrity of floor to floor construction.

B. Take care to prevent injury, discoloration or defacement of other finish materials; and do no cutting or fitting of finish material.

1.10 CLEANING

A. Upon completion of the installation, clean and remove all oil and debris. Clean and polish and leave bright all fixtures and metal work intended to be exposed. Clean out the piping systems and all fixtures, traps and cleanouts. Leave all work in perfect operating condition.

B. Should any pipe, duct or any part of the apparatus be stopped by refuse after the apparatus has been accepted, pay for the disconnecting, cleaning and reconnection, wherever necessary, for the purpose of location and removing the obstruction. Pay for repairs to adjoining work required thereby.

1.11 DRAWINGS

A. The drawings are diagrammatic, and not intended to show every detail of construction or arbitrary location of piping. Where building construction makes it advisable or necessary to change location of piping or fixtures, without increasing the scope of work, perform such work without additional cost, on written order or consent of the Engineer.

B. Install the work as shown. In case of conflict with building parts, or the work of other trades, immediately request a decision be rendered so that there may be no delay in the building construction.

C. Submit for written approval, single line diagrams of any proposed changes or modification to the drawings, at least one week before prices are due.

1.12 QUALITY ASSURANCE

A. Submit catalog cuts and brochures for approval of all proposed materials to be used on the project.

B. Materials and equipment under the section shall be new and of the best grade.
   1. Materials shall conform to the requirement of the State of Rhode Island Plumbing Code, local city requirements, and standards listed such as commercial USAS or ASTM and requirements specifically stipulated herein.

C. All plumbing products used within the domestic water system are to meet or exceed NSF/ANSI 61 Standard requirements for lead-free products.

D. Unless otherwise specified, apply and pay for all necessary permits, fees, and inspections required by any public authority having jurisdiction.

E. Submit copies of manufacturer's recommendation on installing pipe for approval.

F. In addition to other requirements specified herein, the Contractor shall furnish notarized test reports and methods of test by an approved independent testing laboratory to show compliance of all materials furnished under this section of the specifications with all specification requirements and pipe manufacturer's notarized certificates of conformance stating that all materials to be furnished under these items conform with all specification requirements. Each shipment of pipe and pipe fittings shall be accompanied with the pipe manufacturer's notarized certificate of conformance, certifying that the pipe and pipe fittings meet all requirements of the specifications. All testing of all materials furnished under this section of the specifications shall be provided by the Contractor at no additional expense to the Owner.

G. Where items of equipment and/or materials are specified or materials are specified or identified herein by manufacturer's names, model or catalog numbers, only such specified items may be used.

H. Submit, in booklet form, all plumbing fixtures and related accessories for any fixtures and/or equipment different than the manufacturers listed. Submit catalog cuts of both manufacturers.

I. Submit complete maintenance and operational charts and manuals for all equipment and fixtures specified, indicated or required for this work.

J. On completion of the work, attach 1-1/2" diameter brass or embossed plastic as manufactured by Seton Nameplate Company consecutively numbered tags to all valves, also furnish two (2) typewritten charts (framed and glazed) showing all valve numbers with their location and riser controls. Identify all equipment with laminated plastic (lamicoid) nameplates fastened to the equipment as approved. These numbered valves to be shown on Record Drawings.

K. Keep on file, at job site, a clean set of prints to clearly and accurately note all changes, wherever work is installed other than shown. After completion of work, provide a corrected set of drawings in PDF format on CD labeled "Record Drawings" and (2) sets of prints.

1.13 ACCESSIBILITY

A. Be responsible for sufficiency of shafts and chases, with adequate clearances for the proper installation of the work. Cooperate with all other contractors, whose work is in the same space, and advise the Contractor of all requirements. Keep such spaces and clearances to the minimum size required.

B. Locate all equipment, which must be operated, serviced or maintained, in fully accessible locations. Equipment includes, but is not limited to: valves, traps, cleanouts and drain points. If required for better accessibility, provide access doors. Make minor deviations to allow for better accessibility, however, review such changes with the Architect/Engineer.

1.14 COORDINATION

A. Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.15 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

A. Refer to General Conditions (and Supplementary Conditions), Shop Drawings, Product Data and Samples and add the following:
   1. Within thirty (30) days after the date of notice to proceed and before purchasing any materials or equipment, submit to the Architect for review, a complete list, in six (6) copies, of all materials to be incorporated in the work. This listing shall be arranged by the order of occurrence in the specifications, followed by the items on the drawings not specifically included in the specifications.
   2. After the list has been processed by the Architect, submit complete shop drawings and product data of all equipment. These submittals shall be submitted within thirty (30) days after the processing date of the original submittal list.
   3. All submittals shall be complete and shall be in three-ring loose-leaf binders. No consideration will be given to partial submittals, except with prior approval of the Architect. Each item shall have a cover page stating project, specification and paragraph reference number, of drawing reference number, and scheduled equipment identification number, if applicable.
   4. The review of submittals does not relieve this Contractor from the responsibility of shop drawing errors in details, sizes, quantities, wiring diagram arrangements and dimensions which deviate from the specifications, contract drawings, and/or job conditions as they exist.
   5. Changes to work already performed made necessary by delays in shop drawing review are the responsibility of this Contractor.
   6. Copies of equipment and system guarantees shall be submitted with shop drawing package.

B. Refer to General Conditions (and Supplementary Conditions) for substitution of equipment.

C. If apparatus or materials are substituted for those specified under this section, and such substitutions necessitate changes in or additional connects, supports or construction, same shall be provided at no additional cost to the Owner. This Contractor shall assume cost and entire responsibility thereof. Architect's permission to make such substitution shall not relieve this Contractor from full responsibility for work.

1.16 RECORD DRAWING

A. The General Contractor shall provide two (2) sets of black line on white record drawings to this Contractor, one set of which shall be maintained at the site and one set of which shall, at all times, be accurate, clear and complete, showing the actual location of all equipment and piping. The record drawings shall be available to the Architect's/Engineer's field representative at all times.

B. Any addenda sketches, supplementary drawings and change orders issued during the course of construction shall be transferred to the record drawings.

C. At the completion of this contract, this Contractor shall submit through the General Contractor an accurate checked set of record drawings.

D. Non-availability of record drawings or inaccuracies therein shall postpone the final inspection until they are available.

E. After approval of these record drawings, photo reproductions of the original tracings shall be revised to incorporate all the changes on the record drawings. These photo reproductions shall be certified by this Contractor as correct and delivered to the Architect together with two (2) sets of black line prints.

F. All costs related to the foregoing requirements shall be paid for this Contractor.

G. All valves shown on these drawings shall be numbered with numbers corresponding to those on the valve charts.

1.17 USE OF ELECTRONIC DRAWING FILES

A. If requested, the Engineer will provide electronic copies of selected CAD (Computer Aided Design) drawing files for the Contractor's use in the preparation of shop drawings, coordination drawings, or as-built drawings related to this project, subject to the terms and conditions in the following paragraphs.

B. The Engineer's electronic files are prepared on AutoCAD. The Engineer will provide drawing files through Release 2008.

C. Data contained on these electronic files is part of the Engineer's instruments of service and shall not be used by the Contractor or anyone else receiving this data through or from the Contractor for any purpose other than as a convenience in the preparation of shop drawings, coordination drawings, or as-built drawings for the referenced project. Any other use or reuse by the Contractor or by others will be at the Contractor's sole risk and without liability or legal exposure to the Engineer. In accepting these files, the Contractor shall agree to make no claim and shall waive, to the fullest extent permitted by law, any claim or cause of action of any nature against the Engineer, its officers, directors, and employees, agents of the Engineer, which may arise out of or in connection with the Contractor's use of the electronic files.

D. Furthermore, the Contractor shall to the fullest extent permitted by law, indemnify and hold harmless the Engineer from all claims, damages, losses and expenses, including attorney's fees arising out of or resulting from the Contractor's use of these electronic files.

E. These electronic files are not contract documents. Significant differences may exist between these electronic files and corresponding hard copy contract documents due to software incompatibility, software translation, addenda, change orders or other revisions. The engineer makes no representation regarding the accuracy or completeness of these electronic files. In the event that a conflict arises

between the hard copy contract documents prepared by the Engineer and the electronic files, the hard copy contract documents shall govern. The Contractor is responsible for determining if any conflict exists.

1. By use of these electronic files, the Contractor is not relieved of his duty to fully comply with the contract documents, including and without limitation, the need to check, confirm and coordinate all work with that of other contractors for the project.

F. Because of the potential that the information presented on the electronic files can be modified, unintentionally or otherwise, the Engineer reserves the right to remove all indication of their respective ownership and/or involvement form each electronic file provided.

G. A service fee of $100.00 per sheet shall be remitted directly to the Engineer prior to delivery of the electronic files. Arrangements shall be made directly with the Engineer for files prepared by them. Electronic files will not be released until payment is received. A written release to be prepared by the Engineer will be required as well.

H. Under no circumstances shall delivery of the electronic files for use by the Contractor be deemed a sale by the Engineer, who makes no warranties, either expressed or implied, of merchantability and fitness for any particular purpose. In no event shall the Engineer or its consultant (s) be liable for any loss of profit or any consequential damages arising out of the use of these electronic files.

1.18 WARRANTY

A. Refer to General Conditions and add the following:

1. Standard equipment guarantees offered by the manufacturer for on (1) year or greater shall be in addition to that as required by this contract.
2. Copy of manufacturer’s equipment guarantees shall be submitted with this Contractor’s written guarantee.

PART 2 - PRODUCTS

2.1 INDIRECT WASTE PIPING

A. Type L copper with copper DWV sweat fittings.

B. Plastic pipe, Schedule 40, DWV (ASTM D-1785 and ASTM D-2665), unless indicated otherwise.

2.2 CLEANOUTS

A. Provide raised square head cleanout plugs, where possible.

B. Provide Zurn ZN-1447-BP-VP for all areas where wall thickness is insufficient to install stainless steel or steel access doors, vandal proof, bronze plug.

2.3 WASTE AND VENT PIPING:

A. Aboveground Piping: (unless otherwise indicated)

1. Solid plastic piping, PVC Schedule 40 DWV, Iron pipe Sizes (IPS) conforming to ASTM D-1785 and ASTM D-2665. PVC DWV solvent cement fittings are to conform to ASTM D-2665. Pipe and fittings are to be manufactured to the nominal dimensions cited in the applicable ASTM standard, and to be manufactured by one manufacturer.

2. Foam core PVC piping is not allowed on this project. All foam core piping installed on project is to be removed and replace at no additional cost to owner.
3. Provide chrome plating for all exposed piping to plumbing fixtures in classrooms, and finished rooms, etc., including chrome plated traps.
4. Chrome plate all exposed traps and water supplies, whether insulated or not, including piping covered with Trap-Wrap.

2.4 TRAPS

A. Provide standard N.Y. Reg. "P" traps.

B. All fixtures with waste connections shall be properly trapped and vented in accordance with the requirements of the State Plumbing Code and Plumbing Inspector.

2.5 SLEEVES, INSERTS AND ESCUTCHEONS

A. For all openings required in concrete floors, concrete walls and masonry walls; install sleeves of proper size, or masonry is set. Provide wrought iron and steel pipe sleeves for all sleeves through floors or walls, sizes as approved, and packed as required. Extend sleeves one inch above floor for exposed piping passing through the floor.

B. Fit all exposed uncovered pipes passing through walls, in cabinets, floors and ceilings with chromium plated spun or split type escutcheons with clamping device for holding in position.

C. Typical for all piping.

D. This contractor is to verify that all fire stopping is compatible with each piping system.

E. Coordinate all sleeving requirements with fire stopping contractor.

F. Coordinate with Fire Stopping contractor all sleeving material types and sleeve sizes to conform to the appropriate U.L. fire-stopping details per the hourly requirements specified in Division 7. Sleeving is required for all piping through floors, walls install sleeves in accordance with manufacturer's printed instructions.

2.6 HANGERS AND ANCHORS

A. Support all piping from the building structure by means of approved hangers and cast iron concrete inserts or lag bolts. Support piping to maintain required grading and pitching of lines, to prevent vibration and to secure piping in place, and arrange so as to provide for expansion and contraction. Provide approved anchors.

B. Provide all acid, waste, vent stacks and other pipe risers with friction clamp at each floor level and where required.

C. Provide clevis ring type hangers for piping with adjustable device, and machine threaded hanger rods. Provide copperized hangers for water piping. Size of rods shall follow schedule in NFPA Bulletin No. 13.

D. Provide hangers with double nuts.

1. Submit physical samples for approval.

E. Provide insulation protection shields: galvanized 20 gauge by 10” long for all insulated piping where hanger is installed outside the insulation sized to suit pipe size and insulation thickness.

F. IA band is acceptable.

G. For plastic piping, tape all metal hangers, clamps, etc., prior to attachment (for plastic protection).

   1. Option: Provide plastic coated hangers.

H. Provide Grinnell expansion case concrete fasteners #117 for piping 3" and over where drilling of concrete is required. Submit expansion type fasteners.

2.7 ABOVEGROUND WATER PIPING

A. Install all piping in accordance with manufacturer's published recommendations and requirements and governing water department.

B. Provide fittings, bends, offsets, flanges, etc. of approved pattern. Make branch connections from hot water risers to fixtures with appropriate joints to receive expansion stresses.

C. Provide ASTM B 88, Type L for all domestic water piping; cold, hot and hot water returns.

D. Use SilvaBrite 100 Lead-Free solder on cold water and hot water piping. Provide non-corrosive, lead-free type flux conforming to ASTM B813 washable.

E. Provide pipe manufactured by Cerro, Mueller, Anaconda, and Cambridge-Lee Industries with streamlined sweat fittings at each change in direction.

   1. No bent tubing will be accepted.
   2. Coordinate with drawings and this section for additional locations of water hammer arrestors.

F. Copper Press Type Fittings:

   Manufactures, Copper Press Fittings:

   Viega North America, 3 Alfred Circle, Bedford, MA 10730, 877- 843-4262 or Ridge Tool Co., 400 Clark Street, Elyria, OH 44036, 800-519-3456

   Material:

   ASTM B88 and ANSI/ASME B16.22. O-rings for copper press fittings shall be EPDM.

   Press connections for domestic water copper piping ½” to 2”:

   Copper press fittings and installation are to be made in strict accordance with the manufacturers installation instructions. All tubing is to be reamed and de-burred prior to the installation of the fitting. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.

All valves used within a copper press-fit piping system are to be sweat type as specified under the valve section of this specification. Provide all adaptors necessary to provide sweat ball valves all sizes.

Provide copper press fit type system on domestic water piping only for pipe sizes ½” to 2”.

2.8 WATER HAMMER ARRESTORS

A. Provide Zurn Shoktrol #Z-1700, stainless steel, J.R. Smith or Watts SS series; with adaptors, sizes as required to suit manufacturer's recommendations, PDI and ASSE Standards and job conditions. Submit drawings with detailed locations and types to be used.

B. Provide water hammer arrestors at each electric solenoid valve location, unless indicated otherwise.

C. Provide water hammer arrestors at all fixture batteries with more than two (2) fixtures, unless noted otherwise.

D. Provide stainless steel access panels at all water hammer arrestors, for ease of maintenance.

2.9 DIELECTRIC FITTINGS

A. Provide NSF/ASSI 61 approved dielectric fittings when changing from ferrous to non-ferrous piping, fittings, valves, etc.; as manufactured by Watts, LF-3000 Series.

B. Where copper or brass contact ferrous material, provide protective wrapping rubber, or sheet lead wrapped around either to avoid electrolysis.

2.10 VALVES (By domestic manufacturer)

A. The entire plumbing system shall be provided with valves located to permit easy operation, replacement and repair and to permit complete control of all systems under this heading. Throttling valves shall be of the globe type and installed in all lines where regulation or modulation of flow is required. Swing check valves shall be installed in all lines where flow may reverse from that intended.

B. Check Valves: up to 3" size Nibco S-413-B-LF Apollo or Watts.

C. Ball Valves (Watts, Apollo or Nibco):

1. 1/2" to 2" - Watts No. LF-B-6080, Apollo 77FLF full port.
2. 2-1/2" to 4" - Watts No. LF-B-6000 Apollo 77FLF Series.

D. Provide holes drilled in valve handles for valve tags.

E. Drain Cocks: Watts LF-B-6000-CC, Apollo 70LF103HC with chain and cap, 1/2 inch draw-off type with Watts #8A Vacuum Breaker.

1. Provide draw-offs at low points.

2.11 NATURAL GAS PIPING

A. Provide Schedule 40 black steel piping with black malleable fittings, for piping above slab.

B. Pitch piping for drainage; install drip and valve and plug at all low points.

C. Valves 1" to 3": Bronze body screw type ball valve, full port, Watts #B-6000 YRPV-UL.

D. Valves 1" and smaller: gas cock tee handle Rockford #141 with check pin.

E. Solenoid Valves are to be wired to control panels by Electrical Contractor.

F. Valves on gas piping are to be same manufacturer as those used on water piping, including holes in handles for valve tags.

2.12 INSULATION

A. Cold Water: 1 inch fiberglass or approved equal, low pressure pipe insulation, fire retarded with Universal (white) vapor barrier finish. Provide material by Owens-Corning, Johns-Manville or Certainteed.

B. Hot Water: Insulation similar to cold water.
   1. Provide 1½" thick insulation on all pipe sizes up to 2" on all hot water piping only.

C. Hot Water, Tempered Water and Hot Water Return: Insulation type is to be similar to cold water.

   1. Provide 1½" thick insulation on all pipe sizes up to 2" on all tempered water and hot water piping only.

D. Fittings and Valve Insulation:

   1. Hydraulic setting combination insulating and finishing cement.
   2. Molded or fabricated fitting covers of equal thickness and identical in composition to adjacent pipe insulation.

      a. Zeston Premolded Fittings.

   3. All materials, including vapor barrier jackets, glass cloth jackets, adhesives, etc. shall be fire-retardant.

E. Insulate all water pipe, valves and fittings, etc.

F. Reinstall existing pipe covering damaged, disturbed, or removed during the course of construction at no additional cost. Identically match existing insulation thickness.

G. Provide 1" pipe insulation with protective metal jacket for all exposed acid vent pipe risers in classroom areas.

H. Provide, at all handicapped lavatories and sinks, P-trap and angle stop assemblies "Trap-Wrap Protective Kit #500R-AM" manufactured by Brocar or Truebro Lav Guard. Abrasion resistant cover shall be smooth, with white finish and a minimum 1/8" thick cushioned foam wall insert. Provide concealed fastenings. Provide units to suit offset drains at sinks.

2.13 ACCESS PANELS

A. Provide Type "A" Milcor Style "K" or "M" access panels, Karp or Acudor; sizes as required to obtain access to concealed valves, water hammer arrestors, traps and cleanouts. Provide rated panels in rated walls. Provide stainless steel panels where located in Toilet Rooms.

B. Provide vandal proof units in all public areas.

C. Coordinate installation of access panels with the work of Division 8.

2.14 MISCELLANEOUS

A. Provide chrome escutcheons and exposed piping.

B. Provide all fixtures supported from wall with 2" x 6" wood blocking concealed, built into wall, and securely fastened. (Unless fixture supports are specified elsewhere.)

C. Provide McGuire heavy duty supplies and stops.

2.15 EQUIPMENT (Furnished by others)

A. Provide all connections with necessary wastes, traps, backflow preventers, cold and hot water, gas, supplies and stops at each piece of equipment or outlet so that each facility can be separately shut down. Provide chrome piping where exposed in finished areas.

2.16 COMPRESSED AIR PIPING

A. Type “L” copper pipe and fittings similar to water piping. Only sweat joints are to be used on compressed air piping system. Connect all air piping to existing mains.

B. Valves:

1. Similar to valves used for water piping.

   a. Locate valves as indicated.
   b. Provide new valves to replace existing in ½” CA drops.

2. Provide branch pressure reducing valves equal to Quincy Company.
3. Take care that all dirt is removed from lines prior to operation.
4. Provide ball valve and plug on all low points.
5. Provide drip leg on any trapped portion of the main. Install at low point for drainage.
6. All valves same manufacturer as water piping.

2.17 ACID WASTE AND VENT PIPING:

A. Manufacturer: SCHOTT North America, Inc.

1. Contact: 555 Taxter Road, Elmsford, NY 10523; Telephone: 800-633-4505; Fax: 914-831-2201; E-mail: info@us.schott.com; website: www.us.schott.com.
2. Single Source Responsibility: Provide components and materials specified in this section from a single manufacturer.
3. Substitution Limitations:

   a. Substitutions: In accordance with Contract Conditions.

4. Description:
5. Regulatory Requirements:

a. In accordance with Section [01 41 00 - Regulatory Requirements].
b. Listed with UL 723 for use in fire-rated assemblies.
c. Listed with International Association of Plumbing and Mechanical Officials.

6. Compatibility:

a. Ensure components and materials are compatible with specified accessories and adjacent materials.

B. Provide a complete acid waste drain and vent system, as indicated, including, but not limited to, straight lengths of glass pipe, fittings and traps, couplings, hanger supports and accessories. Protected pipe during installation and provide recommended adapter couplings to connect other piping materials.

C. Materials:

1. Glass Pipe: KIMAX Glass Drainline.

a. Above Ground:

1) 5 Foot (1.5 m) Pipe Lengths: 6500 Series.
2) 10 Foot (3 m) Pipe Lengths: 6501 Series.

b. Comply with the following standards:

1) ASTM E438.
2) ASTM C1053.
3) MIL-P-22561-B.

2. Connectors: KIMAX compression type bead-to-bead (#6650) and bead-to-plain end (#6661) couplings.
a. Outer Shell: Encapsulating stainless steel band, 300-series stainless steel.
b. Coupling Compression Liner: Buna-N-Rubber.
c. Seal Ring Gasket: Tetra-fluoro ethylene (TFE).
d. Nut, Bolt: Stainless steel.

D. Pipe Fittings: Sweeps, bends, reducers, tees, cleanouts, wyes, cup sinks and traps, as provided by the piping manufacturer.

E. Hardware: Adapters, sink outlet assemblies, tailpiece assemblies, gaskets, couplings and pipe hangers, as provided by the piping manufacturer.

F. Verification of Conditions: Verify that conditions of substrates previously installed under other sections or contracts are acceptable for product installation in accordance with manufacturer's instructions prior to drain and vent piping system installation.

1. Inform Owner, Architect, Consultant of unacceptable conditions immediately upon discovery.
2. Proceed with installation only after unacceptable conditions have been remedied.
3. Ensure structure or substrate is adequate to support drain and vent piping system.
4. Coordinate installation of drain and vent piping system in accordance with manufacturer’s instructions.
5. Coordinate drain and vent piping system work with work of other trades for proper time and sequence to avoid construction delays.
6. Install drain and vent piping system plumb or sloped, as indicated.
7. Accurately fit, align, securely fasten and install free from distortion or defects.

G. Protect installed product from damage during construction in accordance with Section [01 76 00 -

Protecting Installed Construction].

H. Repair damage to adjacent materials caused by [insert section subject matter] installation.

I. Support horizontal piping continuously with "U" or "V" shaped channels of 18 gauge sheet metal; with sizes and hangers or as required by pipe manufacturer.

PART 3 - EXECUTION

3.1 ACID WASTE AND ACID VENT PIPING:

A. Install acid waste and vent piping in accordance with the latest published Manufacturers installation instructions and requirements.

B. Provide adequate waste from fixtures, evenly pitched and properly secured with adjustable iron hangers. Install all pipes as specified, below grade, and pitch at the rate of 1/4 inch per foot or as approved.

C. Bends and Branches:
1. Provide all necessary bends, branches, etc. Make all changes in direction, fixture connections, etc. with Y branches and 45 degree elbows; offsets on vertical lines at an angle not less than 45 degrees with the vertical, being at a less angle wherever practicable. Use long sweep bends at bottom of stacks. Use certain combination and revent fittings only upon approval, after a specific one or type is submitted for approval.

D. Cleanouts:
1. Provide cleanouts same size as pipe and where indicated and at the ends of all branches, and at each change in direction of horizontal building drain greater than 45 degrees, on waste , and in such other portions where cleanouts are required.

3.2 TRAPS AND VENTS

A. Separately trap every fixture, vent all traps.

B. Install all trap screws (brass) below water line.

3.3 JOINTS

A. Threaded Joints:

1. American National taper screw threads, with graphite and oil compound applied to the male threads or Teflon tape.
2. Provide Blue Magic for all gas piping and Select Whyte for all other piping; as manufactured by Whitlaw.

B. Copper piping joints according to the following:

1. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.

C. Acid Waste Piping:

1. Install all piping and fittings in complete accordance with manufacturer’s recommendations. Do not allow masonry and/or concrete to be against piping.

2. Threading of P.V.C. piping is not allowed.

3.4 HANGERS AND ANCHORS:

A. Horizontal Piping: Support the following materials at the following maximum distance intervals:

1. Acid Waste Pipe: 5 feet.
2. Threaded Pipe: 10 feet.
3. Copper Tubing (1-1/2 inch or less): 6 feet.
4. Copper Tubing (2 inch or over): 10 feet.

3.5 WATER PIPING

A. Ream all cut tube to full inside diameter of pipe. Install all piping in accordance with manufacturer's recommendations and requirements, and local water company standards.

3.6 VALVES

A. Provide valves located as follows and as indicated:

1. At foot of all supply risers, branches to separate fixtures, cold and hot supplies.
2. Provide each fixture supply with a separate angle or straight stop, finished like the pipe it serves.
3. At the foot of each riser on the upper side of the control valve, provide a 1/2 Tee and drain cock in addition to valve.

3.7 GAS PIPING

A. Do all work in accordance with the State of Rhode Island Fuel Gas Code regulations.

B. Do all work in accordance with A.G.A. regulations and local ordinances.

3.8 INSULATION

A. Submit samples of each type of material specified herein for approval.

B. Apply insulation in strict accordance with manufacturer's recommendations.

C. Provide insulating material with a maximum thermal conductance (C Value) of 0.50, low pressure pipe.

D. Cold Water: Seal all joints and seams with white or colorless vapor adhesive.

E. Hot Water and Hot Water Return: Except fastening agent shall be outward clench staples as manufactured by Bostitch.

F. Insulate fittings, valves, etc., with Fiberglas Aerocors or approved equal, to the same thickness as the adjacent pipe insulation, and finished with the same finish.

3.9 DRAINS

A. Obtain the exact information relative to finish grades at the tops of the drain.

3.10 TESTING

A. Pressure test new piping only. Do not test any existing piping. All system leaks which occur due to testing are to be repaired at no additional cost to the Owner.

B. Test all piping and make water-or-gas-tight before insulation is applied, or before concealment.
   1. Acid Waste and Acid Vent Piping: Before the installation of any fixtures, cap the ends of the system and fill all lines with water to the roof, 10 LF head will be acceptable, and let stand until a thorough inspection has been made by Local Inspector and the Engineer.
   2. Test hot and cold water piping to a hydrostatic pressure of 125 pounds per square inch for a period of 24 hours.
   3. Sterilization of water distribution system; as soon as the water distribution system has been flushed out, sterilize the system in accordance with the requirements of the Health Department having jurisdiction or, in the absence of such, by any other method satisfactory to the Owner. Chlorine used for disinfection is to be NSF 60 certified for potable water use.
   4. Test gas piping to 25 psi of air for a period of six (6) hours for above ground installation, and 100 psi for all underground work.
   5. Test compressed air piping for 24 hours at 125#.

3.11 EQUIPMENT CONNECTIONS

A. Connect plumbing lines to all mechanical equipment and all fixtures of this and other sections of this specification. Provide necessary traps, backflow preventers, tail pieces, stops and supplies, to heating equipment and other appurtenances necessary for a complete installation. All exposed piping in finished rooms to be chrome on brass.

3.12 INSTRUCTION OF OWNER'S PERSONNEL

A. Fully instruct the Owner's representative in the complete operation, adjustment and maintenance of the entire installation as directed. Arrange with the suppliers of installed equipment and/or systems to provide the services of expert technicians to instruct owner's operating personnel in the use, care and emergency repair of equipment and/or systems. The period of instruction will be as to satisfy the Architect and/or Engineer that such instructions have accomplished their purpose.

3.13 COLOR CODING AND IDENTIFICATION

A. Conformance: American National Standards Institute Standard A13.1, "Scheme for the Identification of Piping Systems".

B. Requirements: Paint on each pipe its contents and flow direction (if flow is in both directions, use double headed arrow).

C. Locations:

   1. Apply stencil adjacent to each valve.
   2. Apply stencil and arrow on each branch and riser take-off.
   3. Apply stencil and arrow a minimum of 25 feet apart in long continuous lines.
   4. Apply stencil and arrow on lower quarters on pipes or where unobstructed from view.
   5. Apply stencil and arrow at every point of entry or exit thru wall, ceiling or floor.

3.14 INSTRUCTION MANUAL

A. One month prior to the completion of all work and the final inspection of the installation by the Owner, submit for approval two copies of a complete Instruction Manual, bound in a three-ring binder, typewritten and suitably indexed, containing the following minimum data:

1. List of all equipment with manufacturer's name and model number of each item.
2. Manufacturer's literature describing each item of equipment.
3. Copy of each valve chart.
4. Parts list of each major item of equipment.

END OF SECTION

SECTION 23 00 00 – MECHANICAL TABLE OF CONTENTS

23 05 00 – Common Work Results for HVAC
23 05 29 – Hangers and Support for HVAC Piping and Equipment
23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment
23 05 53 – Identification for HVAC Piping and Equipment
23 05 93 – Testing, Adjusting and Balancing for HVAC
23 07 00 – HVAC Insulation
23 09 00 – Instrumentation and Control for HVAC
23 21 13 – Hydronic Piping
23 31 13 – Metal Ducts
23 33 00 – Air Duct Accessories
23 37 13 – Diffusers, Registers and Grilles
23 73 13 – Indoor Air Handling Units

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Drawings and General Provisions of Contract, including General and Modifications to General Conditions and Division 1 Specification Sections, apply to work specified in this Section.

B. Equality of materials, articles, assembly or systems, other than those named or described in this Section, will be determined in accordance with the provisions given to Substitutions.

C. All work in this Section is subject to the codes and standards of this Section unless otherwise listed in Section 230548, which will take precedence.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Inserts.
7. HVAC demolition.
8. Equipment installation requirements common to equipment sections.
9. Supports and anchorages.
10. Cutting and patching.
11. Painting.
12. Electrical wiring.
13. Vibration Isolation and seismic controls.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

D. "Contractor" means specifically sub-contractor working under his respective Section of the Specifications.

E. "Furnish" and "Provide" mean to supply, erect, install and connect up complete in readiness for regular operation, particular work referred to, unless otherwise specified.

F. "Piping" includes, in addition to pipe, all fittings, valves, hangers and other accessories relating to such piping.

G. "Ductwork" includes, in addition to ducts, all fittings, hangers, dampers, elbows, transitions, access panels, breaker strips, flexible connections and other accessories relating to ductwork.

H. "Supply" means purchase and delivery of material to the site.

I. "Install" means to erect in place the supplied item.

1.4 SUBMITTALS

A. Submit color samples for pipe coding system.

B. Submit copies for approval and record of:

1. All Tests.
2. Balancing Report.
3. Valve Chart.
4. Pipe Color Code Chart.
5. Maintenance Manuals.
6. All products and materials supplied under Division 23.

C. Any additional cost or loss, or damage arising from the substitution of any material or method for those originally specified shall be borne by the Contractor, notwithstanding review or acceptance of such substitution by the owner or the Architect, unless the substitution was made at the written request of the Owner. Any cost for re-design of any components of the contract documents shall be borne by the Contractor, unless the substitution was made at the written request of the Owner.

D. Submittals shall be used by the contractor to coordinate location and size of access requirements, and location of piping, duct, drain, and electrical connections. Where the submittal is lacking proper information, the contractor shall obtain certified drawings or manufacturers installation brochures and instructions for the equipment before proceeding with the work.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code – Steel."

B. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 SCOPE OF WORK

A. Provide all labor, materials, equipment, controls and accessories necessary to complete the work shown on the Drawings or herein specified.

B. The work to be done under this Division includes all related work shown on the Drawings and or included in these Specifications.

1.7 MATERIALS

A. Any device, material or construction required to complete the job that is not specifically covered by description herein shall be of commercial-grade material normally used for the purpose and installed in a manner consistent with the conditions of use. Items exposed to the elements shall be

weatherproofed or protected. All such items shall be submitted for review before being purchased or installed.

1.8 CODES AND STANDARDS

A. Materials and equipment shall be designed, constructed, installed and tested in accordance with this Specification and the latest editions of the following applicable standards in addition to state and local codes applying. All products shall bear the label of approval from the appropriate agency.

Agencies:

National Environmental System Contractors Assoc.	NESCA
Air Moving and Conditioning Association	AMCA
American Society of Heating, Refrigerating and Air Conditioning Engineers	ASHRAE
American Society of Mechanical Engineers	ASME
Federal Construction Safety Standards (U.S. Dept. of Labor)	FCSS
American Society of Testing Materials	ASTM
National Electric Code	NEC
National Electrical Manufacturers Association	NEMA
National Fire Code	NFC
Occupational Safety and Health Act of '70	OSHA
International Building Code (Latest Edition)	IBC
National Sanitation Foundation	NSF
Air Conditioning and Refrigeration Inst.	ARI
Underwriters Laboratories, Inc.	UL
Building Officials & Code Administrators International, Inc.	BOCA
International Code Council	ICC
National Fire Protection Association	NFPA
Sheet Metal and Air Conditioning Contractors National Association	SMACNA
American National Standards Institute	ANSI
American Welding Society	AWS
Cast Iron Soil Pipe Institute	CISPI
Clean Air Act Amendment of 1990 (Title VI. Section 608)	CAA
Cooling Tower Institute	CTI
International Mechanical Code	IMC

B. Any materials or workmanship called for in the above-mentioned requirements which are not specified or shown on the Drawings, shall be furnished and installed by the Contractors as though same had been specifically mentioned or indicated.

C. If these Contractors fail to notify the architect and engineer at this time, and install work in variance with the above-mentioned codes and regulations, they shall assume responsibility and expense to rectify the installation to the satisfaction of the architect, engineer and Owner.

D. Secure all local, state and federal permits necessary in connection with the installation of the equipment, including licenses and approvals and pay fees required for same.

E. All work shall be performed in strict accordance with the above-mentioned standards, local and state codes.

F. File all necessary Plans and Documents with Local Authorities and obtain the necessary Certificates of Inspection for work. Deliver same to architect and engineer prior to request for acceptance and final payment.

G. Notify architect and engineer of any deviation from codes of work indicated or herein specified before installation of work is affected.

1.9 WORK PROCEDURE

A. The Contractor shall, in good workmanlike manner, perform all work and furnish all supplies and materials, machinery, equipment and means, herein and otherwise specified, necessary or proper to perform and complete all work required by the Plans and Specifications in order to have a complete and satisfactory installation acceptable to the A/E.

1.10 COOPERATION WITH OTHER TRADES / COORDINATION DRAWINGS

A. Cooperate to fullest extent with all other trades to best expedite the entire work.

B. Furnish all information pertaining to materials, sizes, locations, means of support, etc., to all other trades requiring such information.

C. Where work of Contractor will be installed in close proximity to work of other trades, or where there is evidence that work of Contractor will interfere with work of other trades, he shall assist in working out space conditions to make satisfactory adjustment.

D. Contractor shall prepare composite working "COORDINATION" drawings and sections at suitable scale not less than ¼" = 1'-0" clearly showing how his work is to be installed in relation to work of other trades. The contractor shall identify any conflicts and request assistance from the Architect / Engineer for assistance in resolving a field condition in order to complete the work required. No additional compensation will be granted or awarded for resolving coordination issues since this is considered part of this contractor's duties.

PART 2 - PRODUCTS

2.1 GENERAL

A. All products shall be new and without defects.

B. Products required by construction but not specifically described herein shall be as selected by the Contractor subject to the approval of the architect and engineer.

C. All products of Section 230548 shall take preference over the products of this Section.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12.

G. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.4 UNIONS / DIELECTRIC FITTINGS

A. Use dielectric unions, flanges, or waterways to connect dissimilar metal parts.

B. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

C. Insulating Material: Suitable for system fluid, pressure, and temperature.

D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.5 SLEEVES

A. Through outside masonry walls and below grade masonry walls, use schedule 40 ductile iron, caulked watertight.

B. Through masonry floors or interior masonry walls and fire rated assemblies, use Schedule 40 galvanized steel pipe.

C. Through interior non-fire rated stud partitions, use 22-gauge galvanized sheet metal.

D. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

E. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

F. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

G. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

H. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

I. PVC Pipe: ASTM D 1785, Schedule 40.

J. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

A. Escutcheons for pipes passing through interior walls, partitions and ceilings shall be split-hinged, cast brass, chromium plated type, Ritter Pattern & Casting Co., #3A.

B. Beaton & Corbin and/or Caldwell products will be acceptable.

2.7 INSERTS

A. Inserts shall be individual or strip type, of pressed steel construction galvanized only with accommodation for removable nuts and threaded rods up to ¾" diameter, permitting lateral adjustment. Individual inserts shall have an opening at top to allow reinforcing rods up to ½" diameter to be passed through insert body and shall be Fee & Mason Manufacturing Company, Figure 178. Strip inserts shall have attached rods with hooked ends to allow fastening to reinforcing rods and shall be Fee & Mason Manufacturing Company, Figure 190. Grinnell or Carpenter Patterson materials will be acceptable.

B. At Contractor's option, inserts may by galvanized, malleable iron, Universal type, Grinnell, Figure 279, for pipe sized up to 3½", Figure 282, for all sizes up to 8".

C. Where subject to corrosive atmospheres use stainless steel products.

PART 3 - EXECUTION

3.1 GENERAL

A. All installation methods of Section 230548 shall take precedence over the methods of this Section.

3.2 INTERPRETATION OF DRAWINGS

A. Mechanical equipment and such other apparatus as may require maintenance and operation from time to time shall be made easily accessible. Although the equipment may be shown on the Drawings in certain locations, the construction may disclose that such locations do not make its position readily accessible. In such cases, the Owner or his Representative shall be notified before advancing the construction to a stage where a change will reflect additional expense.

B. Compare actual site conditions with the Drawings and Specifications and include additional work which careful examination would disclose. Before the bidding period, advise the architect and engineer of any omission, error or conflict in the Plans and Specifications.

C. Equipment, ductwork and piping locations, as shown, are diagrammatic and approximate only unless fixed by dimensions. Actual field conditions and physical characteristics of the product govern exact

locations. Where possible, adhere to locations on Drawing consistent with building construction and equipment installed by others.

D. Contractor shall not scale measurements from the Drawings but check with General Contractor's latest Drawings, shop drawings, and equipment manufacturers' installation guides before proceeding with any work.

E. Work layouts shall be the responsibility of the Contractor, following minimum requirements as set forth in these Specifications and accompanying Drawings.

F. Where head room or space conditions appear inadequate, the architect and engineer shall be notified before proceeding with installation. If directed by architect or engineer, Contractor shall, without extra charge, make reasonable modifications in layout as needed to prevent conflicts with work of other trades or for proper execution of work.

G. If, in Contractor's opinion, work is shown or specified in manner or amount as to make it impossible to install a first-class piece of work or fulfilling intent of a perfectly efficient job when complete, refer same to architect and engineer in writing before submitting proposals.

H. Should Contractor fail to refer such instances to architect or engineer as required above, no excuse for poor, defective or incomplete work will be accepted.

3.3 SHOP DRAWINGS

A. All equipment shall be submitted for approval under these Sections to the architect and engineer.

B. Do not place orders for any equipment until final approval is received. Allow at least two weeks for submittal review.

C. If material or equipment is purchased or installed before it is approved, Contractor shall be liable for removal and/or replacement at no extra charge to the Owner.

D. Contractor shall consult manufacturers' installation brochures and instructions to determine exact location of connection points. Take special care to allow for proper space for maintenance, removal of coils, filters and equipment. Provide offset pipe and union arrangements for ease of removal of coils and equipment. Provide accessories required or recommended by the manufacturer. Locate drains for proper pitch and trapping for coils, space for control valves, and other components. Coordinate with electrical contractor by advising of proper location of attachment of electrical devices to be clear of areas of maintenance or access.

3.4 WARRANTY

A. Refer to General Conditions. The warranty period for the work under this Section is for one year from date of acceptance. These contractors shall provide free day-and-night service, parts and labor for the complete installation of the entire system for this period.

3.5 CONTRACTOR'S RESPONSIBILITY

A. Contractor shall be held responsible for any injuries to people, employees or damage done to building premises or adjoining areas or to other work resulting from execution on his part of work, in any manner whatsoever.

B. Contractor shall be responsible for proper protection of his work, materials, people or employees from injury or loss done by others and shall make good such injury at his own expense.

C. The Engineer shall not be responsible for the safety of Contractor's employees.

3.6 CUTTING AND PATCHING

A. All rough cutting and patching required for installation of the mechanical system shall be the responsibility of this contractor. All finish patching relative to this contractor's work shall be the responsibility of other trades in accordance with other sections of this specification. Coordinate all work for a complete and finished installation.

3.7 TESTING

A. Contractor shall submit to the architect and engineer for record and approval a written report for each test conducted. Report shall indicate date of test, system tested, method of testing, name of person or agency witnessing test, and results of tests. If test records are not kept and submitted, it will be assumed that the test was not completed and Contractor will be required to perform the test at architect's or engineer's direction.

B. All piping, ducts and equipment shall be tested. Contractor shall furnish Labor, materials, instruments and power required for testing unless otherwise indicated under particular section of Specifications.

C. Tests shall be performed in presence of and to satisfaction of the architect, engineer and/or such other parties as may have jurisdiction.

D. Pressure test shall be applied to piping only before connection of equipment. In no case shall piping, equipment or accessories be subjected to pressures exceeding their ratings.

E. Defective work shall be promptly repaired or replaced and tests shall be repeated until particular system and/or component parts receive approval of the architect and engineer.

F. Any damages resulting from tests shall be repaired and damaged materials replaced.

G. Duration and style of tests shall be as determined by authorities having jurisdiction but in no case less than time prescribed in each Section of Specifications. In general, pressure for tests shall be 1.5 times working pressure unless prescribed otherwise by code, specific specification section or ASTM Guidelines.

H. Equipment and systems which normally operate during certain seasons of year shall be tested during appropriate season. Test shall be performed on individual equipment, systems and their controls for proper operation, functioning and performance. Latter shall be operated simultaneously with equipment of system being tested.

I. During testing procedure, remove accessories liable to damage during tests.

J. Notice shall be furnished to A/E at least two days prior to any testing. Contractor shall be solely responsible for any delays, damages, etc., resulting from failure to notify.

K. Instruments required under this Contract for permanent installation may be used for testing if readjusted and recalibrated for the service for which intended.

3.8 CLEANING OF SYSTEM

A. All piping, ducts and equipment shall be thoroughly cleaned of foreign matter after being placed in operation. System shall be disconnected, cleaned and reconnected wherever necessary to locate and remove obstructions. Any work damaged in course of removing obstructions shall be repaired or replaced when system is reconnected at no additional cost to the Owner.

3.9 SLEEVES, INSERTS, ANCHOR BOLTS

A. Sleeves shall be located by this Contractor and set by the General Contractor, subject to approval by the architect and engineer. Provide General Contractor with such information in ample time to prevent unnecessary cutting and patching. Mechanical Contractor shall be responsible for and subsequent cutting and patching of openings if sleeves have been omitted due to failure of setting them properly or in time. Fasten sleeves securely to avoid dislocation during concrete pouring.

B. In placing sleeves, inserts, anchor bolts or any other material to be embedded in masonry and concrete or built into structure, Contractor shall cooperate with all other trades and shall consult with architect and engineer in regard to their exact locations wherever there is any interference with structural members.

C. Contractor will be held responsible for location of and maintaining in proper positions, sleeves, inserts and anchor bolts supplied and/or set in place by him. In event that failure to do so requires cutting and patching of finished work, it shall be done at Contractor's expense.

D. All pipes and conduits passing through floors, walls or partitions shall be provided with sleeves having an internal diameter two inches larger than outside diameter of pipe.

E. Sleeves through outside walls shall be painted with one coat of bitumastic paint inside and outside. Sleeves shall extend ½" beyond each side of wall. Space between sleeve and pipe shall be packed with oakum to within two inches of each face of wall. Remaining space shall be packed and made watertight with a waterproof compound.

F. Sleeves through masonry floors or interior masonry walls shall be set flush with finished wall or ceiling surfaces.

G. Sleeves through interior stud partitions shall be set flush with finished surfaces of partitions.

3.10 ESCUTCHEONS

A. Escutcheons shall be installed on pipes wherever they pass through floors, ceilings, wall partitions and outside walls where exposed to view.

3.11 OPERATING INSTRUCTIONS

A. Operation of system:

1. Contractor is responsible for construction and installation of all mechanical systems and shall supply the services of competent personnel for a period of three days to instruct owner's personal. As such, Contractor may be required during the first year to review every phase of all mechanical systems with Owner's personnel and also to instruct and supervise Owner's personnel in the proper operation and maintenance of said system. Time shall be recorded by Contractor and signed by Owner or Representative.
2. Contractor shall also provide three sets of complete operating instructions of all systems installed, bound in a manual. Manual shall contain one approved copy of each shop drawing and submitted

data, printed instructions as to care and maintenance of system, and bound in a hard cover and arranged in the following sequence:

a. Table of Contents
b. Description of Installation
c. Care and Maintenance: Including a check and follow-up chart for greasing and oiling of all mechanical equipment and a copy of instructions as to upkeep of motors.
d. Manufacturer's Listing: In alphabetical order, of all equipment installed on job, together with a listing of material supplied, manufacturer’s address, name and address of local manufacturer’s agent.
e. Copy of Valve Charts
f. Copy of Pipe System complete with color samples.

3.12 PROJECT CLOSEOUT AND TROUBLE SHOOTING

A. Each trade shall designate one person to methodically test, adjust, trouble shoot and effect repairs to all equipment, devices and systems. The person shall be available on one hour’s notice to answer trouble calls and to fully investigate and repair the cause of the problem. Each trade shall submit the name and phone number of the designated person to the Owner, Engineer and Architect. After final acceptance, this same person shall be available on eight hour’s notice for free day-and-night service during the guarantee period.

B. Contractor shall demonstrate all sequences of control to the Engineer. The temperature control and balancing sub-contractors shall accompany the Engineer during check-out procedure and shall demonstrate proper balancing positions of minimum fresh-air settings. Personnel shall be equipped with tools and spare parts to make minor repairs and adjustments.

C. Contractor shall demonstrate compliance with balancing of systems in the presence of the Engineer by actual measurement of water and air flows at a minimum of three locations randomly selected by the Engineer. If requested by the Engineer, re-balancing shall be done at no additional charge.

3.13 FIRE STOPPING

A. Each trade is responsible for fire stopping of its own work.

B. Fire stopping material shall be typical of HILTI Fire Barrier.

C. Each trade must submit intended fire stopping material and methods for each application with UL listed approved designs.

3.14 HVAC DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.

4. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.15 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

P. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.16 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

H. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

I. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.17 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.18 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

END OF SECTION

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses.

1. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Revise list below to suit Project.
2. Trapeze pipe hangers.
3. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Remaining paragraph is defined in Division 01 Section "Submittal Procedures" as an "Informational Submittal." Retain paragraph if retaining procedures for welder certification in "Quality Assurance" Article.

E. Welding certificates.

1.4 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.4 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.5 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Verify suitability of fasteners in two subparagraphs below for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick.
2. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
3. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2 : 12 inches long and 0.048 inch thick.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches .

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
3. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
4. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
5. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.

8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Hangers for horizontal lines, except as noted below and in Section 230500 -

1. Vibration Isolation and Seismic Restraint, shall be spaced no greater than as follows:

Pipe Size	Rod Diameter	Maximum Spacing	
		Copper	Steel
½”	3/8”	5’ - 0”	7’ - 0”
¾”	3/8”	5’ - 0”	7’ - 0”
1”	3/8”	6’ - 0”	7’ - 0”
1¼”	3/8”	7’ - 0”	7’ - 0”
1½”	3/8”	8’ - 0”	9’ - 0”
2”	3/8”	8’ - 0”	10’ - 0”
2½”	1/2”	9’ - 0”	11’ - 0”
3”	1/2”	10’ - 0”	12’ - 0”
4” - 5”	5/8”	12’ - 0”	14’ - 0”
6” - 8”	3/4”	14’ - 0”	17’ - 0”

2. Copper tubing shall be supported with split ring hangers, copperized with supporting rod.
3. Cast iron soil pipe shall be hung one hanger for each pipe length, close to hub.
4. PVC pipe shall be supported no more than 4'-0” on center.
5. Use insulation protection saddles or shields for all insulated cold piping and where hanger is outside the insulation. Secure all saddles and shields to the insulation to prevent slippage or shifting that may cause the shield to fall to the ground. Saddles shall be spot welded to hangers.

R. Hangers for vertical pipes shall be spaced no greater than as follows:

PIPING MATERIAL	MAX. VERTICAL SPACING
Cast Iron Pipe	15’-0”
Copper Pipe/Tubing	10’-0”
Galvanized Steel Pipe	15’-0”
PVC Pipe	4’-0”
CPVC Pipe/Tubing	3’-0”

END OF SECTION

SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Intent

1. All mechanical equipment, piping and ductwork shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.
2. All isolators and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.
3. It is the intent of the seismic portion of this Specification to keep all mechanical building system components in place during a seismic event.
4. All such systems must be installed in strict accordance with seismic codes, component manufacturers' and building construction standards. Whenever a conflict occurs between the manufacturers' or construction standards, the most stringent shall apply.
5. This Specification is considered to be minimum requirements for seismic consideration and is not intended as a substitute for legislated, more stringent, national, state or local construction requirements (i.e., California Title 24; California OSHPD; Canadian Building Codes; or, other requirements).
6. The Contractor shall correct any variance or non-compliance with these Specification requirements in an approved manner.
7. Seismic restraints shall be designed in accordance with seismic force levels as detailed in the State Building Codes.
8. All in-line equipment will be braced independently of the ducts or pipes and in conformance with all applicable building codes.

B. The work in this Section includes, but is not limited to, the following:

1. Vibration isolation for piping, ductwork and equipment.
2. Seismic restraints for all new gas piping and sprinkler piping.
4. Flexible piping connections.
5. Seismic restraints for equipment.
7. Certification of seismic restraint designs and installation supervision.
9. All mechanical systems. Equipment referred to below is typical (equipment not listed is still included in this Specification):

   Air Handling Units
   Ductwork
   Heat Exchangers
   Life Safety Systems
   Piping

C. Definitions

1. Life Safety Systems:

a. All systems involved with fire protection including sprinkler piping, fire pump control panels, service water supply piping, and fire dampers.
b. All systems involved with and/or connected to emergency power supply.
d. Fresh-air relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.
e. All life-safety equipment.

2. Positive Attachment:

a. A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double-sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided "C" type beam clamps for support rods of overhead piping, ductwork, fire protection, electrical conduit, bus duct, or cable trays, or any other equipment are not acceptable on this project as seismic anchor points.

3. Transverse Bracing:

a. Restraint(s) applied to limit motion perpendicular to the centerline of the pipe, duct or conduit.

4. Longitudinal Bracing:

a. Restraint(s) applied to limit motion parallel to the centerline of the pipe, duct or conduit.

1.2 SUBMITTAL DATA REQUIREMENTS

A. The manufacturer of vibration isolation and seismic restraints shall provide submittals for products as follows:

1. Descriptive Data:

a. Catalog cuts or data sheets on vibration isolators and specific restraints detailing compliance with the Specification.
b. Detailed schedules of flexible and rigidly mounted equipment, showing vibration isolators and seismic restraints by referencing numbered descriptive Drawings.

2. Shop Drawings:

a. Submit fabrication details for equipment bases including dimensions, structural member sizes and support point locations.
b. Provide all details of suspension and support for ceiling hung equipment.
c. Where walls, floors, slabs or supplementary steel work are used for seismic restraint locations, details of acceptable attachment methods for ducts, conduit and pipe must be included and approved before the condition is accepted for installation. Restraint manufacturers' submittals must include spacing, static loads and seismic loads at all attachment and support points.
d. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.

3. Seismic Certification and Analysis:

a. Calculations shall be based on “G” forces appropriate for the zone in which the building is located.

b. Seismic restraint calculations must be provided for all connections of equipment to the structure. Calculations must be stamped by a Registered Professional Engineer with at least five years of seismic design experience, licensed in the State of the job location.
c. All restraining devices shall have a pre-approval number from California's OSHPD or some other recognized government agency showing maximum restraint ratings. Pre-approvals based on independen-dent testing are preferred to pre-approvals based on calculations. Where pre-approved devices are not available, submittals based on independent testing are preferred. Calculations (including the combining of tensile and shear loadings) to support seismic restraint designs must be stamped by a Registered Professional Engineer with at least five years of seismic design experience and licensed in the State of the job location. Testing and calculations must include shear and tensile loads as well as one test or analysis at 45° to the weakest mode.
d. Analysis must indicate calculated dead loads, static seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedment and/or welded length. All seismic restraint devices shall be designed to accept, without failure, the forces detailed in the State Building Code acting through the equipment center of gravity. Overturning moments may exceed forces at ground level.

1.3 CODE AND STANDARDS REQUIREMENTS

A. Typical Applicable Codes and Standards

1. Applicable State Building Code.
2. Applicable State Mechanical Code.
3. Applicable State Plumbing and Gas Codes.
4. SMACNA
5. NFPA

1.4 MANUFACTURERS' RESPONSIBILITIES

A. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities:

1. Determine vibration isolation and seismic restraint sizes and locations.
2. Provide vibration isolation and seismic restraints as scheduled or specified.
3. Provide calculations and materials if required for restraint of un-isolated equipment.
4. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.

1.5 RELATED WORK

A. Supplementary Support Steel:

1. Contractor shall supply supplementary support steel for all equipment, piping, ductwork, etc., including roof mounted equipment, as required or specified.

B Attachments:

1. Contractor shall supply restraint attachment plates cast into housekeeping pads, concrete inserts, double-sided beam clamps, etc., in accordance with the requirements of the vibration vendor's calculations.

PART 2 - PRODUCTS

2.1 INTENT

A. All vibration isolators and seismic restraints described in this Section shall be the product of a single manufacturer. Mason Industry's products are the basis of these Specifications; products of other manufacturers are acceptable provided their systems strictly comply with the Specifications and have the approval of the specifying engineer. Submittals and certification sheets shall be in accordance with Section 230500.

B. For the purposes of this project, failure is defined as the discontinuance of any attachment point between equipment or structure, vertical permanent deformation greater than 1/8” and/or horizontal permanent deformation greater than ¼”.

2.2 PRODUCT DESCRIPTIONS

A. Vibration Isolators and Seismic Restraints:

SPECIFICATION:

1. Two layers of ¾" thick neoprene pad consisting of 2" square waffle modules separated horizontally by a 16 gauge galvanized shim. Load distribution plates shall be used as required. Pads shall be Type Super "W" as manufactured by Mason Industries, Inc. or equal.
2. Bridge-bearing neoprene mountings shall have a minimum static deflection of 0.2" and all-directional seismic capability. The mount shall consist of a ductile iron casting containing two separated-and-opposing molded neoprene elements. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation. The shock absorbing neoprene materials shall be compounded to bridge-bearing specifications. Mountings shall have an Anchorage Preapproval "R" Number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Mountings shall be Type BR as manufactured by Mason Industries, Inc. or equal.
3. Sheet metal panels shall be bolted to the walls or supporting structure by assemblies consisting of a neoprene bushing cushioned between two steel sleeves. The outer sleeve prevents the sheet metal from cutting into the neoprene. Enlarge panel holes as required. Neoprene elements pass over the bushing to cushion the back panel horizontally. A steel disc covers the inside neoprene element and the inner steel sleeve is elongated to act as a stop so tightening the anchor bolts does not interfere with panel isolation in three planes. Bushing assemblies can be applied to the ends of steel cross members where applicable. All neoprene shall be bridge-bearing quality. Bushing assemblies shall be Type PB as manufactured by Mason Industries, Inc. or equal.
4. A one-piece molded bridge bearing neoprene washer/ bushing. The bushing shall surround the anchor bolt and have a flat washer face to avoid metal-to-metal contact. Neoprene bushings shall be Type HG as manufactured by Mason Industries, Inc. or equal.
5. Spring isolators shall be free standing and laterally stable without any housing and complete with a molded neoprene cup or ¼” neoprene acoustical friction pad between the baseplate and the support. All mountings shall have leveling bolts that must be rigidly bolted to the equipment. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflection, compressed spring height and solid spring height. Mountings shall be Type SLF as manufactured by Mason Industries, Inc. or equal.
6. Restrained spring mountings shall have an SLF mounting as described in Specification 5, within a rigid housing that includes vertical limit stops to prevent spring extension when weight is re-

moved. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of ½" shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Limit stops shall be out of contact during normal operation. Since housings will be bolted or welded in position there must be an internal isolation pad. Housing shall be designed to resist all seismic forces. Mountings shall have Anchorage pre-approval “R" number from OSHPD in the State of California certifying the maximum certified horizontal and vertical load ratings. Mountings shall be SLR as manufactured by Mason Industries, Inc. or equal.

7. Spring mountings, as in Specification 5, built into a ductile iron or steel housing to provide all directional seismic snubbing. The snubber shall be adjustable vertically and allow a maximum of ¼” travel in all directions before contacting the resilient snubbing collars. Mountings shall have an Anchorage pre-approval "R" number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Mountings shall be SSLFH as manufactured by Mason Industries, Inc. or equal.
8. Air Springs shall be manufactured with upper and lower steel sections connected by a replaceable flexible nylon reinforced neoprene element. Air spring configuration shall be multiple bellows to achieve a maximum natural frequency of 3 Hz. Air springs shall be designed for a burst pressure that is a minimum of three times the published maximum operating pressure. All air spring systems shall be connected to either the building control air or a supplementary air supply and equipped with three leveling valves to maintain leveling within plus or minus 1/8". Submittals shall include natural frequency, load and damping tests performed by an independent lab or acoustician. Air springs shall be Type MT and leveling valves Type LV, as manufactured by Mason Industries, Inc. or equal.
9. Restrained air spring mountings shall have an MT air spring, as described in Specification 8, within a rigid housing that includes vertical limit stops to prevent air spring extension when weight is removed. The housing shall serve as blocking during erection. A steel spacer shall be removed after adjustment. Installed and operating heights are equal. A minimum clearance of ½" shall be maintained around restraining bolts and between the housing and the air spring so as not to interfere with the air spring action. Limit stops shall be out of contact during normal operation. Housing shall be designed to resist all seismic forces. Mountings shall be SLR-MT as manufactured by Mason Industries, Inc. or equal.
10. Hangers shall consist of rigid steel frames containing minimum 1¼" thick neoprene elements at the top and a steel spring with general characteristics, as in Specification 5, seated in a steel washer reinforced neoprene cup on the bottom. The neoprene element and the cup shall have neoprene bushings projecting through the steel box. To maintain stability the boxes shall not be articulated as clevis hangers nor the neoprene element stacked on top of the spring. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc from side-to-side before contacting the rod bushing and short circuiting the spring. Submittals shall include a hanger drawing showing the 30° capability. Hangers shall be Type 30N, as manufactured by Mason Industries, Inc. or equal.
11. Hangers shall be as described in paragraph 10 above, but they shall be precompressed and locked at the rated deflection by means of a resilient seismic upstop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Submittals shall include a drawing of the hanger showing the 30° capability. Hangers shall be Type PC30N, as manufactured by Mason Industries, Inc. or equal.
12. Seismic Cable Restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement. Cables must not be allowed to bend across

sharp edges. Cable assemblies shall have an Anchorage pre-approval "R" number from OSHPD in the State of California verifying the maximum certified load ratings. Cable assemblies shall be Type SCB at the ceiling and at the clevis bolt, SCBH between the hanger rod nut and the clevis or SCBV if clamped to a beam, all as manufactured by Mason Industries, Inc. or equal.

a. Cables will be wire-core with a minimum breaking strength as shown in the table below. The cable size is for reference only. The actual cable size should be chosen to provide the breaking strength indicated in the table. Use FS = 2.0 when pre-stretched cable is used with end connections that develop the breaking strength of the cables; otherwise, use FS = 5.0.

Minimum Breaking Strength for Cable Braces

Size inches	Breaking Strength FS = 2.0 pounds	Breaking Strength FS = 5.0 pounds
¼	4,940	12,350
3/8	10,980	27,450
½	19,260	48,150

b. Cable will be zinc-coated to a minimum of 0.4 ounces per square foot or stainless steel per ASTM A304. Tighten cable only to remove slack.
c. Use either cable or solid bracing for all situations. Do not mix bracing types.

13. Seismic solid braces shall consist of steel angles or channels to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint. Seismic solid, brace-end connectors shall be steel assemblies that swivel to the final installation angle and utilize two through bolts to provide proper attachment. Seismic solid brace assembly shall have anchorage pre-approval "R" number from OSHPD in the State of California verifying the maximum certified load ratings. Solid seismic brace assemblies shall be Type SSB, as manufactured by Mason Industries, Inc. or equal.

a. Cold-formed angles will conform to the material and identification requirements of the latest *Specifications for the Design of Cold-Formed Steel Structural Members* of the American Iron and Steel Institute with a minimum Fy = 33 ksi and a minimum Fu = 38 ksi.
b. The uncoated minimum steel thickness of the cold-formed product as delivered to the job site will not, at any location, be less than 95% of the thickness indicated in the table below. The thickness may be less at bends after cold-forming.

Standard Sheet Metal Gages

Gage	Standard Uncoated Thickness inches	Galvanized Thickness inches
12	0.1046	0.1084
14	0.0747	0.0785
16	0.0598	0.0635

c. Hot-rolled shapes and plates will conform to ASTM A36. Pipes used as braces will be standard steel pipes (ASTM A120 or A53).

Note: Specifications 12 through 14 apply to trapeze as well as clevis hanger locations. At trapeze anchor locations, piping must be shackled to the trapeze. Specifications apply to hanging equipment as well.

14. Steel angles, sized to prevent buckling, shall be clamped to pipe or equipment rods utilizing a minimum of three ductile iron clamps at each restraint location when required. Welding of support rods is not acceptable. Rod clamp assemblies shall have an Anchorage pre-approval "R" number from OSHPD in the State of California. Rod clamp assemblies shall be Type SRC, as manufactured by Mason Industries, Inc. or equal.
15. Pipe clevis cross-bolt braces are required in all restraint locations. They shall be special purpose, pre-formed channels deep enough to be held in place by bolts passing over the cross bolt. Clevis cross braces shall have an Anchorage pre-approval "R" number from OSHPD in the State of California. Clevis cross braces shall be type CCB, as manufactured by Mason Industries, Inc. or equal.
16. All-directional seismic snubbers shall consist of inter-locking steel members restrained by a one-piece-molded neoprene bushing of bridge bearing neoprene. Bushing shall be replaceable and a minimum of ¼” thick. Rated loadings shall not exceed 1,000 psi. A minimum air gap of 1/8” shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces. Snubber end caps shall be removable to allow inspection of internal clearances. Neoprene bushings shall be rotated to insure no short circuits exist before systems are activated. Snubbers shall have an Anchorage pre-approval "R" number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Snubber shall be Type Z-1225, as manufactured by Mason Industries, Inc. or equal.
17. All directional seismic snubbers shall consist of interlocking steel members restrained by shock absorbent rubber materials compounded to bridge bearing specifications. Elastomeric materials shall be replaceable and a minimum of ¾" thick. Rated loadings shall not exceed 1,000 psi. Snubbers shall be manufactured with an air gap between hard and resilient material of not less than 1/8" nor more that ¼". Snubbers shall be installed with factory-set clearances. The capacity of the seismic snubber at 3/8" deflection shall be equal or greater than the load assigned to the mounting grouping controlled by the snubber multiplied by the applicable "G" force. Submittals shall include the load deflection curves up to ½" deflection in the X, Y and Z planes. Snubbers shall have an anchorage pre-approval "R" number from OSHPD in the State of California verifying the maximum certified horizontal and vertical load ratings. Snubbers shall be series Z-1011, as manufactured by Mason Industries, Inc. or equal.
18. Stud wedge anchors shall be manufactured from full diameter wire, not from undersized wire that is "rolled up" to create the thread. The stud anchor shall also have a safety shoulder, which fully supports the wedge ring under load. The stud anchors shall have an evaluation report number from the I.C.B.O Evaluation Service, Inc. verifying its allowable loads. Drill-in stud wedge anchors shall be type SAS, as manufactured by Mason Industries, Inc. or equal.
19. Female wedge anchors are preferred in floor locations so isolators or equipment can be slid into place after the anchors are installed. Anchors shall be manufactured from full diameter wire and shall have a safety shoulder to fully support the wedge ring under load. Female wedge anchors shall have an Evaluation Report Number from the I.C.B.O Evaluation Service, Inc. verifying to its allowable loads. Drill-in female wedge anchors shall be Type SAB, as manufactured by Mason Industries, Inc. or equal.
20. Vibration isolation manufacturer shall furnish integral structural steel bases. Rectangular bases are preferred for all equipment. Centrifugal refrigeration machines and pump bases may be T or L shaped where space is a problem. Pump bases for split case pump shall include supports for suction and discharge elbows. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 14" provid-

ed that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to provide a base clearance of 1". Bases shall be type WF, as manufactured by Mason Industries, Inc. or equal.

21. Vibration isolation manufacturer shall furnish rectangular steel concrete pouring forms for floating and inertia foundations. Bases for split case pumps shall be large enough to provide for suction and discharge elbows. Bases shall be a minimum of 1/12 of the longest dimension of the base but not less than 6". The base depth need not exceed 12" unless specifically recommended by the base manufacturer for mass or rigidity. Forms shall include minimum concrete reinforcing consisting of ½" bars welded in place on 6" centers running both ways in a layer 1½" above the bottom. Forms shall be furnished with steel templates to hold the anchor bolts' sleeves and anchors while concrete is being poured. Height-saving brackets shall be employed in all mounting locations to maintain a 1" clearance below the base. Wooden-formed bases leaving concrete rather than a steel finish are not acceptable. Base shall be type BMK or K, as manufactured by Mason Industries, Inc. or equal.
22. Curb mounted rooftop equipment shall be mounted on spring isolation curbs. The lower member shall consist of a sheet metal Z section containing adjustable and removable steel springs that support the upper floating section. The upper frame must provide continuous support for the equipment and must be captive so as to resiliently resist wind and seismic forces. All directional neoprene snubber bushings shall be a minimum of ¼" thick. Steel springs shall be laterally stable and rest on ¼" thick neoprene acoustical pads. Hardware must be plated and the springs provided with a rust resistant finish. The curbs' waterproofing shall consist of a continuous galvanized flexible counter flashing nailed over the lower curbs' waterproofing and joined at the corners by EPDM bellows. All spring locations shall have access ports with removable waterproof covers. Lower curbs shall have provision for 2" of insulation. The roof curbs shall be built to seismically contain the rooftop unit. The unit must be solidly fastened to the top floating rail and the lower Z section anchored to the roof structure. Curb shall have anchorage pre-approval "R" from OSHPD in the State of California attesting to the maximum certified horizontal and vertical load ratings. Curb shall be type RSC, as manufactured by Mason Industries, Inc. or equal.
23. Flexible spherical expansion joints shall employ peroxide cured EPDM in the covers, liners and Dacron tire cord frictioning. Solid steel rings shall be used within the raised face, rubber ends to prevent pullout. Flexible cable bead wire is not acceptable. Sizes 2" and larger shall have two spheres reinforced with a ring between spheres to maintain shape and complete with split ductile iron or steel flanges with hooked or similar interlocks. Sizes 16" to 24" may be single sphere. Sizes ¾" to 1½" may have threaded bolted flange assemblies, one sphere and cable retention. 14" and smaller connectors shall be rated at 250 psi up to 190°F with a uniform drop in allowable pressure to 190 psi at 250°F. 16" and larger connectors are rated 180 psi at 190°F and 135 psi at 250°F. Safety factors to burst and flange pullout shall be a minimum of 3/1. All joints must have permanent markings verifying a five-minute factory test at twice the rated pressure. Concentric reducers to the above specifications may be substituted for equal-ended expansion joints.

    Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirement without control rods, as control rods are not desirable in seismic work. If control rods are used, they must have ½" thick Neoprene washer bushings large enough in area to take the thrust at 1,000 psi maximum on the washer area. Expansion joints shall be installed on the equipment side of the shut-off valves.

    Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer. All expansion joints shall

be installed on the equipment side of the shut-off valves. Expansion joints shall be SAFEFLEX SFDEJ, SFEJ, SFDCR or SFU and Control Rods CR, as manufactured by Mason Industries, Inc. or equal.

24. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes shall have male nipples. Minimum lengths shall be as tabulated:

Flanged	Male Nipples
3 x 14	½ x 9
4 x 15	¾ x 10
5 x 19	1 x 11
6 x 20	1¼ x 12
8 x 22	1½ x 13
10 x 26	2 x 14
12 x 28	2½ x 18
14 x 30	
16 x 32	

Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible. Hoses shall be type BSS, as manufactured by Mason Industries, Inc. or equal.

25. All-directional acoustical pipe anchor, consisting of two sizes of steel tubing separated by a minimum ½" thick, 60 durometer neoprene. Vertical restraint shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads on the isolation material should not exceed 500 psi and the design shall be balanced for equal resistance in any direction. All-directional anchors shall be type ADA, as manufactured by Mason Industries, Inc. or equal.
26. Pipe guides shall consist of a telescopic arrangement of two sizes of steel tubing separated by a minimum ½" thickness of 60-durometer neoprene. The height of the guides shall be preset with a shear pin to allow vertical motion due to pipe expansion or contraction. Shear pin shall be removable and re-insertable to allow for selection of pipe movement. Guides shall be capable of ± 1-5/8" motion or to meet location requirements. Pipe guides shall be type VSG, as manufactured by Mason Industries, Inc. or equal.
27. Split wall seals consist of two bolted pipe halves with minimum ¾" thick neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of l" past either face of the wall. Where temperatures exceed 240° F, 10# density fiberglass may be used in lieu of the ponge. Seals shall be type SWS, as manufactured by Mason Industries, Inc. or equal.
28. The horizontal thrust restraint shall consist of a spring element in series with a neoprene-molded cup as described in Specification 5 with the same deflection as specified for the mountings or hangers. The spring element shall be designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of ¼" movement at start and stop. The assembly shall be furnished with one rod, and angle brackets for attachment to both the equipment and the ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrical on either side of the unit. Horizontal thrust restraints shall be type WBI/WBD, as manufactured by Mason Industries, Inc. or equal.

29. Bolts will conform to ASTM A307. Bolt holes will be a maximum of 1/16” (1.6 mm) larger than the bolt diameter unless noted otherwise.
30. Expansion anchors will have local-governing-jurisdiction-approved values equal to, or greater than, both the shear and tension capacities listed in the table below. Cast-in-place concrete inserts may replace expansion anchors where the approved loads are equal to, or greater than, the values for the specified expansion anchors.

    Minimum Approved Values for Expansion Anchors

Size inches	Shear Capacity pounds	Tension Capacity pounds
3/8	675	615
½	1,130	1,040
5/8	1,580	1,535
¾	2,270	2,020
7/8	5,060	3,705

31. Welding will conform to AWS D1.1 and use either the shielded or submerged arc methods. Attachments to building components may be subject to review by the design professional.

PART 3 - EXECUTION

3.1 GENERAL

A. All vibration isolators and seismic restraint systems must be installed in strict accordance with the manufacturer’s written instructions and all certified submittal data.

B. Installation of vibration isolators and seismic restraints must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.

C. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.

D. The Contractor shall not install any equipment, piping, duct or conduit that makes rigid connections with the building unless isolation is not specified. "Building" includes, but is not limited to, slabs, beams, columns, studs and walls.

E. Coordinate work with other trades to avoid rigid contact with the building.

F. Any conflicts with other trades that will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architect’s and engineer’s attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible Contractor’s expense.

G. Bring to the architect’s and engineer’s attention any discrepancies between the Specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible Contractor’s expense.

H. At no additional cost, correct all installations that are deemed defective in workmanship and materials, at the Contractor's expense.

I. Overstressing of the building structure must not occur because of overhead support of equipment. Contractor must submit loads to the Structural Engineer of record for approval. Generally, bracing may occur from:

1. Flanges of structural beams.
2. Upper truss cords in bar joist construction.
3. Cast-in-place inserts or wedge-type, drill-in concrete anchors.

J. All attachments to structural elements will be reviewed with the appropriate design professional.

K. Specification 12 cable restraints shall be installed slightly slack to avoid short circuiting the isolated suspended equipment, piping or conduit.

L. Specification 12 cable assemblies are installed taut on non-isolated systems. Specification 13 seismic solid braces may be used in place of cables on rigidly attached systems only.

M. At locations where Specifications 12 or 13 restraints are located, the support rods must be braced where necessary to accept compressive loads with Specification 14 braces.

N. At all locations where Specifications 12 or 13 restraints are attached to pipe clevis', the clevis cross bolt must be reinforced with Specification Type 15 braces.

O. Drill-in concrete anchors for ceiling and wall installation shall be Specification Type 18 and Specification Type 19 female wedge-type for floor mounted equipment.

P. Vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not permitted on this project.

Q. Hand built elastomeric expansion joints may be used when pipe sizes exceed 24" or specified movements exceed Specification 23 capabilities.

R. Where piping passes through walls, floors or ceilings the vibration isolation manufacturer shall provide Specification 27 wall seals.

S. Air handling equipment and centrifugal fans shall be protected against excessive displacement that results from high air thrust in relation to the equipment weight. Horizontal thrust restraint shall be Specification Type 28.

T. Locate isolation hangers as near to the overhead support structure as possible.

U. When conduit is required to be braced, it may be braced the same as the equivalent weight pipe.

V. All runs will have a minimum of two transverse braces and one longitudinal brace.

1. A run is defined as a length of duct or pipe without any change in direction except as allowed by offsets

3.2 VIBRATION ISOLATION OF PIPING

A. Horizontal Pipe Isolation: The first three pipe hangers in the main lines near the mechanical equipment shall be as described in Specification 11. Specification 11 hangers must also be used in all transverse braced isolated locations. Brace hanger rods with SRC clamps' Specification 14. Hangers as described in Specification 10 shall isolate horizontal runs in all other locations throughout the building. Floor-supported piping shall rest on isolators as described in Specification 6. Heat exchangers and expansion tanks are considered part of the piping run. The first three isolators from the isolated equipment will have the same static deflection as specified for the mountings under the connected equipment. If piping is connected to equipment located in basements and hangs from ceilings under occupied spaces, the first three hangers shall have 0.75" deflection for pipe sizes up to and including 3"; 1½" deflection for pipe sizes up to and including 6"; and, 2½" deflection thereafter. Hangers shall be located as close to the overhead structure as practical. Where piping connects to mechanical equipment, install Specification 23 expansion joints or Specification 24 stainless hoses if 23 is not suitable for the service.

B. Riser Isolation: Risers shall be suspended from Specification 10 hangers or supported by Specification 5 mountings, anchored with Specification 25 anchors and guided with Specification 26 sliding guides. Steel springs shall be a minimum of 0.75" except in those expansion locations where additional deflection is required to limit load changes to ± 25% of the initial load. Submittals must include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on the building structure, spring deflection changes and seismic loads. Submittal data shall include certification that the riser system has been examined for excessive stresses and that none will exist in the proposed design.

3.3 SEISMIC RESTRAINT OF PIPING

A. Seismically restrain all piping listed as 1, 2 or 3 below. If isolated, use Specification 12 cables. Specifications 12 or 13 restraints may be used on un-isolated piping.

1. Fuel oil piping, gas piping, medical gas piping and compressed air piping.
2. All other piping, 2½" diameter and larger.

B. Transverse piping restraints shall be at 40' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads or is otherwise noted in this Specification.

C. Longitudinal restraints shall be at 80' maximum spacing for all pipe sizes, except where lesser spacing is required to limit anchorage loads or is otherwise noted in this Specification.

D. Where thermal expansion is a consideration, guides and anchors may be used as transverse and longitudinal restraints provided they have a capacity equal to or greater than the restraint loads in addition to the loads induced by expansion or contraction.

E. For fuel oil and all gas piping up to 5", transverse restraints must be at 20' maximum and longitudinal restraints at 40' maximum spacing.

F. Transverse restraint for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24" of the elbow or TEE, or combined stresses are within allowable limits at longer distances.

G. Hold-down clamps must be used to attach pipe to all trapeze members before applying restraints in a manner similar to clevis supports.

H. Branch lines may not be used to restrain main lines.

I. Cast iron pipe of all types, glass pipe and any other pipe joined with a shield-and-clamp assembly where the top of the pipe is 12” or more from the supporting structure, will be braced on each side of a change in direction of 90º or more. Riser joints will be braced or stabilized between floors.

J. Provide joints capable of accommodating seismic displacements where pipes pass through building seismic or expansion joints or where rigidly supported pipes connect to equipment with vibration isolators. The joints must be allowed motion in all directions.

K. A rigid piping system will not be braced to dissimilar parts of the building or to two dissimilar building systems that may respond differently during an earthquake.

L. Vertical risers not specifically engineered will be laterally supported with a riser clamp at each floor. For buildings greater than six stories high, all risers will be engineered individually. For risers in hubless piping systems where the riser joints are unsupported between floors, brace in accordance with provisions of this Section.

3.4 VIBRATION ISOLATION OF DUCTWORK

A. All discharge runs for a distance of 50' from the connected equipment shall be isolated from the building structure by means of Specification 10 hangers or Specification 5 floor isolators. Spring deflection shall be a minimum of 0.75".

B. All duct runs having air velocity of 1,000 fpm or more, shall be isolated from the building structure by Specification 11 hangers or five floor supports. Spring deflection shall be a minimum of 0.75".

3.5 SEISMIC RESTRAINT OF DUCTWORK

A. Seismically restrain all ductwork with Specification 12 or 13 restraints as listed below:

1. Restrain rectangular ducts with cross sectional area of 6 sq. ft. or larger.
2. Restrain round ducts with diameters of 33" or larger.
3. Restrain flat oval ducts the same as rectangular ducts of the same nominal size.

B. Transverse restraints shall occur at 30' intervals or at both ends of the duct run if less than the specified interval. Transverse restraints shall be installed at each duct turn and at each end of a duct run.

C. Longitudinal restraints shall occur at 60' intervals with at least one restraint per duct run. Transverse restraints for one duct section may also act as a longitudinal restraint for a duct section connected perpendicular to it if the restraints are installed within four feet of the intersection of the ducts and if the restraints are sized for the larger duct. Duct joints shall conform to SMACNA duct construction standards.

D. The ductwork must be reinforced at the restraint locations. Reinforcement shall consist of an additional angle on top of the ductwork that is attached to the support hanger rods. Ductwork is to be attached to both upper angle and lower trapeze.

E. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.

F. Unbraced ducts will be installed with a 6” minimum clearance to vertical ceiling hanger wires.

G. Walls, including gypsum board non-bearing partitions that have ducts running through them may replace a typical transverse brace. Provide channel framing around ducts and solid blocking between the duct and frame at all stud wall construction.

3.6 SEISMIC RESTRAINT OF FIRE PROTECTION EQUIPMENT

A. All fire protection piping shall be braced in accordance with NFPA 13 and 14.

B. All fire protection equipment is considered life safety equipment and shall be seismically restrained using the seismic force levels for life safety equipment detailed in the State Building Code if higher levels are shown.

3.7 SEISMIC RESTRAINT OF MECHANICAL EQUIPMENT

A. All mechanical equipment shall be vibration isolated and seismically restrained as per Section 2.02 of this Specification.

3.8 SEISMIC RESTRAINT EXCLUSIONS

A. Piping:

1. All piping less than 2½" in diameter except those listed in Section 3.03, paragraph A.
2. All piping in boiler and mechanical equipment rooms less than 1¼" I.D except where noted otherwise in this Specification and in Section 3.03, paragraph A.1.
3. All clevis or trapeze supported piping suspended from hanger rods where the point of attachment is less than the 12" in length from the structure to top of pipe, except those listed in Section 3.03, paragraph A.1.

B. Ductwork:

1. Rectangular, square or oval ducts less than six square feet in cross sectional area.
2. Round duct less than 33" in diameter.
3. No bracing is required if the duct is suspended by hangers 12” or less in length, as measured from the top of the duct to the bottom of the support where the hanger is attached. Hangers must be positively attached to the duct with 2” of the top of the duct with a minimum of two #10 sheet metal screws.

C. Suspended Equipment:

1. VAV boxes and fan-powered equipment weighing less than 50 lbs. and rigidly connected to the supply side of the duct system and supported with a minimum of four hanger rods.

END OF SECTION

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Common Work Results for HVAC Section 230500 shall apply to all work performed under this Section of the Specifications and shall be considered as included herein.

1.2 SCOPE

A. Provide identification devices specified in this section.

1.3 RELATED SECTIONS

A. All Sections of Division 23 apply to work in this Section.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

a. The following colors shall be used for piping identification unless noted otherwise:

Service	Legend	Background Color
Hot water supply	HWS	Yellow
Hot water return	HWR	Yellow
Chilled Water Supply	CHWS	Yellow
Chilled Water Return	CHWR	Yellow

Note: Color banding shall meet latest edition of NSI and OSHA requirements.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

C. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8 ½ "x 11" bond paper. Tabulate valve number, piping system, system abbreviation (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals.

D. Maintenance Data: Include product data and schedules in maintenance manuals.

1.6 WARRANTIES

A. Provide one year maintenance warranty for all pieces of equipment. See Division 1 for additional warranty requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, products are limited to Seton, Brady or Brimar whom have a minimum of 5 years experience in the manufacturing of mechanical identification products.

2.2 MECHANICAL IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 15 sections. Where more than single type is specified for application, selections is Installer's option, but provide single selection for each product category.

2.3 PAINTED IDENTIFICATION MATERIALS

A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 duct work.

B. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

C. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ANSI A13.1 for colors.

2.4 PLASTIC PIPE MARKERS

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.

B. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1.

C. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125°F or greater. Cut length to extend 2" beyond each end of plastic pipe marker.

D. Small Pipes: For external diameters less than 6” (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Laminated or bonded application of pipe marker to pipe (or insulation).
4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than ¾” wide; full circle at both ends of pipe marker, tape lapped 1 ½”.

F. Lettering: Comply with piping system nomenclature as specified, scheduled or shown, and abbreviate only as necessary for each application length.

1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.5 VALVE TAGS

A. Brass Valve Tags: Provide 1/16” (1.5mm) thick polished brass valve tags with stamp-engraved piping system abbreviation in 3/8” (8mm) high letters and sequenced valve numbers ¾” 918mm) high, and with 1/8” (3mm) hole for fastener.

1. Provide 1 ½” (37mm) diameter tags, except as otherwise indicated.
2. Provide size and shape as specified or scheduled for each piping system.
3. Fill tag engraving with black enamel.

B. Valve Tag Fasteners: Provide manufacturer’s standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

C. Access Panel Markers: Provide manufacturer’s standard 1/16” thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8” center hole to allow attachment.

2.6 VALVE SCHEDULE FRAMES

A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.7 EQUIPMENT LABELS

A. All equipment labels shall be made of 3 ply 3/16” engraved phenolic with low glare finish. Labels shall be electrically non-conductive and abrasion resistant. Labels shall have mounting holes and adhesive backing.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces which required insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, and install identification

after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

B. Where air or hydronic systems have been balanced, the Contractor shall permanently mark, ON THE DEVICE, the correct balancing settling of each valve, damper, or similar device.

3.2 DUCTWORK IDENTIFICATION

A. General: Identify air supply, return, exhaust, and intake ductwork with stenciled signs and arrow, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).

B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50 foot spacing along exposed runs.

C. Access Doors: Provide plastic duct access door markers on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information. Where acoustic ceilings are below the access, provide duplicate marker on ceiling tile, ceiling grid, or ceiling access panel.

3.3 PIPING SYSTEM IDENTIFICATION

A. General: install pipe markers on each system listed on the color chart Paragraph 1.04.B.1.a. indicate nominal pipe size (i.e. 4” HS) and include arrows to show normal direction of flow.

B. Locate pipe markers and color bands as follows wherever piping and ductwork is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations and concealed above ceiling spaces.

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
4. At access doors, manholes and similar access points which permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.
7. On piping above removable acoustical ceilings.

3.4 VALVE IDENTIFICATION

A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures, and HVAC terminal devices 50 mm and smaller and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.

1. Tagging Schedule: Valve tags shall be sequential.

B. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by the Owner.

3.5 EQUIPMENT LABLES

A. Equipment labels shall include, but not limited to the following applicable information:

Schedule Tag	CFM
Equipment Served	Static Pressure
Equipment Manufacturer	Head
Equipment Model	GPM
Horsepower	Valve CV
Fan RPM	lbs/HR
Voltage	Pressure Drop
Zone Served	Type of Service
Filter Size & Quantity	

B. Provide equipment labels for:

Reheat Coils	All Fans & Air Handling Units
Variable Frequency Drives	Control Valve

3.6 ADJUSTING AND CLEANING

A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

3.7 EXTRA STOCK

A. Furnish minimum of 5% extra stock of each mechanical identification material required, including additional numbered valve tags (not less than 12) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

1. Where stenciled markers are provided (ductwork only), clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

END OF SECTION

SECTION 23 05 93 – TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Balancing Air Systems
2. Balancing Hydronic Piping Systems

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 SUBMITTALS

A. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

B. Certified TAB reports.

1.4 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.

B. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms approved by Engineer.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

I. Examine terminal units such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

K. Examine control valves for proper installation for their intended function.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine operating safety interlocks and controls on HVAC equipment.

O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. References:

1. A "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
2. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in U.S. standard inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

   a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

   a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
   b. Measure static pressure directly at the fan outlet or through the flexible connection.
   c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

   a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor

amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, sub-main ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of sub-main and branch ducts.

a. Where sufficient space in sub-main and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Re-measure each sub-main and branch duct after all have been adjusted. Continue to adjust sub-main and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.7 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.8 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.9 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.
4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.10 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the condition of filters.
4. Check bearings and other lubricated parts for proper lubrication.
5. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.11 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: +/- 10%.
2. Air Outlets and Inlets: +/- 10%.
3. Heating-Water Flow Rate: +/- 10%.
4. Cooling-Water Flow Rate: +/- 10%.

3.12 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

3.13 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.

d. Face and bypass damper settings at coils.
e. Fan drive settings including settings and percentage of maximum pitch diameter.
f. Inlet vane settings for variable-air-volume systems.
g. Settings for supply-air, static-pressure controller.
h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

3.14 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

3.15 SPECIAL REQUIREMENTS

A. If readings shown on the balancing report or from actual site visit are not acceptable to the Engineer, the Balancing Contractor shall spot test (witnessed by the Engineer) as many pieces of equipment or air outlets at no additional cost.

END OF SECTION

SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Insulation Materials:

   a. Cellular glass.
   b. Flexible elastomeric.
   c. Mineral fiber.
   d. Polyolefin.
   e. Polystyrene.

2. Fire-rated insulation systems.
3. Insulating cements.
4. Adhesives.
5. Mastics.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied jackets.
10. Tapes.
11. Securements.
12. Corner angles.

B. Related Sections:

1. Division 23 Section "Metal Ducts".
2. Division 23 Section "Hydronic Piping".

C. Scope:

1. Insulate supply & return heating hot water piping.
2. Insulate supply & return chilled water piping.
3. Insulate all copper AC condensate piping.
4. Insulate all supply, return and outside air ducts.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at duct access panels and volume dampers.
8. Detail application at linkages of control devices.
9. Detail field application for each equipment type.

C. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 HEATING HOT WATER PIPING

A. Fiberglass pipe insulation shall be by Owens Corning type SSL-II or approved equal, with factory applied all-service jacket (ASJ) and two-component adhesive closure system, rated for a maximum service temperature of 850F. For large pipe sizes where SSL-II is not available, the single adhesive SSL closure may be substituted. Circumferential joints shall be sealed by butt strips having a two-component sealing system.

1. Piping 1½”.and smaller shall have a minimum insulation thickness of 1½”.
2. Piping larger than 1½”.shall have a minimum insulation thickness of 2”.
3. Insulation thickness is based on a “k” value not exceeding 0.29 Btu per inch/h•ft2•°F at a mean temperature rating of 125°F.

B. Fittings and valves shall be insulated with pre-formed fiberglass fittings. Thickness shall be equal to adjacent pipe insulation. Finish shall be with pre-formed PVC fitting covers.

C. Flanges, couplings and valve bonnets shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as on the main pipe section. An oversized insulation section shall be used to form a collar between the two insulation sections with low-density blanket insulation being used to fill gaps. Jacketing shall match that used on straight pipe sections. Where fittings are to be left exposed, insulation ends should be beveled away from bolts for easy access.

2.2 CHILLED WATER PIPING

A. Molded fibrous glass pipe insulation shall comply with the requirements of ASTM C 547 and meet ASTM C 585 for sizes required in the particular system. It shall be of a self-drying type suitable for installation on piping systems. Product shall include a factory applied integral vapor retarder extending under the evaporator area of the wick and covering not less than 98% of the circumference of the product. Exposed evaporator area shall be not less than 0.1 sq. ft./linear ft. of product. Vapor retarder shall be fungi resistant when tested per ASTM C 1338. Acceptable Manufacturers are Owens Corning

VaporWick® Pipe Insulation or pre-approved equal. PVC jacket covering is not to be used on VaporWick.

1. Piping 1½" and smaller shall have a minimum insulation thickness of 1½".
2. Piping 2" and larger shall have a minimum insulation thickness of 2".
3. Insulation thickness is based on a "k" value not exceeding 0.27 Btu per inch/h•ft^2•°F at a mean temperature difference of 75°F.

B. Fittings and valves shall be insulated per manufacturer's instructions:

1. Fittings and valves shall be wrapped continuously with wicking material prior to installing insulation to ensure a continuous path for removal of condensation.
2. Standard site fabricated connections (e.g. mitered, segmented, or fish mouth) are recommended for bends and fittings.
3. Standard PVC fittings with blanket insulation or molded/preformed fiberglass fittings may be used.
4. Standard oversizing practices shall be used for valves and flanges.

2.3 COOLING CONDENSATE INSULATION

A. Provide and install insulation on all piping and equipment as listed manufactured by Armacell.

1. Copper AC Condensate Piping: 1" thick insulation
2. PVC AC Condensate Piping: No Insulation Required

B. Insulation material shall be a flexible, closed-cell elastomeric insulation in tubular form model APArmaflex SS and AP Armaflex Sheet. Product shall meet the requirements as defined in ASTM C 534, "Specification for preformed elastomeric cellular thermal insulation in sheet and tubular form."

C. Insulation material shall have a closed-cell structure to prevent moisture from wicking, which makes it an efficient insulation.

D. Insulation material shall be manufactured without the use of CFC's HFC's or HCFC's. It shall also be formaldehyde free, low VOC's, fiber free, dust free and resists mold and mildew.

E. Materials shall have a flame spread index of less than 25 and a smoke-developed index of less than 50 when tested in accordance with ASTM E 84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, the flame shall not be progressive and all materials shall pass simulated end-use fire tests.

F. Materials shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft2-ºF at a 75ºF mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.

G. Materials shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure A, latest revision. The material shall be manufactured under an independent third party supervision testing program covering the properties of fire performance, thermal conductivity and water vapor transmission.

H. Armaflex not allowed for use as piping insulation, unless otherwise specified.

2.4 DUCT INSULATION

A. All leakage testing of ductwork to be insulated shall be completed, and resealing of areas found to not be tight, prior to the application of any insulation materials.

B. Supply, return, and outside air intake ductwork shall be insulated with 2.5” thick fiberglass duct insulation for a minimum of R-8 insulation value as manufactured by Owens Corning or approved equal. Insulation shall have a foil-faced vapor barrier.

2.5 PVC PIPE JACKET

A. Provide and install Zeston 300 Series PVC heavy-duty fitting covers and Zeston PVC pipe jacket on all insulated piping in the mechanical room specifically designed for industrial and commercial applications.

B. The following colors shall be used for existing and new piping jacket and fitting covers in the mechanical room only (all other locations shall be provided in standard white color):

Service	**Legend**	**Jacket Color**
Heating Hot Water Supply	Heating Water Supply	Red
Heating Hot Water Return	Heating Water Return	Red
Chilled Water Supply	Chilled Water Supply	Blue
Chilled Water Return	Chilled Water Return	Blue

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Refer to the manufacturer’s written installation instruction & product data sheets for additional information, and for product specific installation requirements and instructions.

B. All testing of ductwork and piping to be insulated shall be completed prior to the application of any insulation materials.

C. All surfaces to be insulated shall be cleaned of all scale, rust, oil, and foreign matter and shall be dry and free of frost prior to and during application of insulation.

D. All insulation and accessory materials shall be stored in an area that is dry and protected from the weather before and during insulation application.

E. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

F. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

G. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

H. Install insulation with longitudinal seams at top and bottom of horizontal runs.

I. Install multiple layers of insulation with longitudinal and end seams staggered.

J. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

K. Keep insulation materials dry during application and finishing.

L. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

M. Install insulation with least number of joints practical.

N. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

O. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

P. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches on center.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches on center.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

Q. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

R. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement after start-up.

S. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

T. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.4 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Supply, return and outdoor air.

B. Items Not Insulated:

1. Factory-insulated plenums and casings.
2. Flexible connectors.

3. Vibration-control devices.
4. Factory-insulated access panels and doors.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

3.7 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches on center.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.8 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.9 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches on center.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums:

1. Secure with adhesive and insulation pins.
2. At volume damper and duct access door locations, cut insulation back to expose damper adjusters and access doors. Tape seal insulation to duct. Provide an insulation “Door” to cover the access point and mark the “Door” with highly visible fluorescent marker or tape.
3. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
4. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
5. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches on center.

b. On duct sides with dimensions larger than 18 inches, place pins 16 inches on center. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not over-compress insulation during installation.
e. Impale insulation over pins and attach speed washers.
f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

6. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch on center. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

7. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches on center.
8. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
9. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches on center.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches on center.
   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches on center. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not over-compress insulation during installation.
   e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent

insulation section with 1/2-inch outward-clinching staples, 1 inch on center. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches on center.

3.10 POLYOLEFIN INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.11 POLYSTYRENE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed section of polystyrene insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.12 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.13 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches on center. and at end joints.

D. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch circumference limit allows for 2-inch overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums:
1. PVC: 20 mils thick.
2. Aluminum, Smooth: 0.016 inch thick.

D. Piping:
1. PVC: 20 mils thick.
2. Aluminum, Smooth: 0.016 inch thick.

END OF SECTION

SECTION 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for heating and cooling equipment not supplied with factory-wired controls.

B. The following specification describes components of the control system required for this project. Provide all components necessary for a complete automatic control system that will accomplish all of the “Sequences of Operations” described in these specifications.

C. The types of system components being installed and controlled are air-handling units, duct reheat coils with control valves, perimeter fin-tube heating elements, and new ATC space sensors.

D. The ATC contractor shall remove and replace the existing duct reheat coil space sensors and replace with new devices. The new devices shall comply with the CCRI space sensor standards. All devices shall be tied into the existing CCRI BMS control system. The ATC contractor shall provide for changing the existing BMS system graphics to reflect all control devices for all project area spaces.

E. The control conductors being installed by the ATC contractor shall be plenum-rated.

1.2 SUBMITTALS

A. Product Data: For each control device indicated.

B. Shop Drawings:

1. Schematic flow diagrams.
2. Power, signal, and control wiring diagrams.
3. Details of control panel faces.
4. Damper schedule.
5. Valve schedule.
6. DDC System Hardware: Wiring diagrams, schematic floor plans, and schematic control diagrams.
7. Control System Software: Schematic diagrams, written descriptions, and points list.

C. Software and firmware operational documentation.

D. Field quality-control test reports.

E. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 CONTROL SYSTEM

A. Provide all control wiring, transformers, components, etc. regardless of voltage, to accomplish the "Sequence of Operation" as stated in these specifications.

B. All new equipment shall be tied into the existing building management system. It is the responsibility of the contractor to coordinate fully with the building owner to accomplish the "Sequence of Operation" as stated in these specifications.

C. The ATC contractor shall remove and replace the existing duct reheat coil space sensors and replace with new devices. The new devices shall comply with the CCRI space sensor standards. All devices shall be tied into the existing CCRI BMS control system. The ATC contractor shall provide for changing the existing BMS system graphics to reflect all control devices for all project area spaces.

2.2 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Comply with CCRI space sensor standards.

2.3 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.

B. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

C. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

D. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

E. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

F. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

G. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

1. Manufacturers:

a. BEC Controls Corporation.
b. I.T.M. Instruments Inc.

2.4 THERMOSTATS (NON-DDC)

A. Manufacturers: (CCRI ATC standards to take preference as directed)

1. Erie Controls.
2. Danfoss Inc.; Air-Conditioning and Refrigeration Div.
3. Heat-Timer Corporation.
4. Sauter Controls Corporation.
5. tekmar Control Systems, Inc.
6. Theben AG - Lumilite Control Technology, Inc.

B. Electric, solid-state, microcomputer-based room thermostat with remote sensor.

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
5. Short-cycle protection.
6. Programming based on every day of week.
7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:

   a. Time of day.
   b. Actual room temperature.
   c. Programmed temperature.
   d. Programmed time.
   e. Duration of timed override.
   f. Day of week.
   g. System mode indications include "heating," "off," "fan auto," and "fan on."

C. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.

D. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.

1. Bulbs in water lines with separate wells of same material as bulb.
2. Bulbs in air ducts with flanges and shields.
3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

E. Room Thermostat Cover Construction: Provide sample for Owner approval.

2.5 CONTROL VALVES

A. Manufacturers: (CCRI ATC standards to take preference as directed)

1. Danfoss Inc.; Air Conditioning & Refrigeration Div.
2. Erie Controls.
3. Belimo

B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

C. Hydronic system globe valves shall have the following characteristics:

1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
2. Internal Construction: Replaceable plugs and stainless-steel or brass seats.

   a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
   b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.

3. Sizing: 3-psig maximum pressure drop at design flow rate or the following:

   a. Two Position: Line size.
   b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
   c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.

4. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
5. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.

D. Self-Contained Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.

2.6 DAMPERS

A. Manufacturers:

1. Air Balance Inc.
2. TAMCO (T. A. Morrison & Co. Inc.).
3. Nailor
4. Greenheck

B. Dampers: AMCA-rated, opposed-blade design; 0.108-inch minimum thick, galvanized-steel or 0.125-inch minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.

1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F .
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.7 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.

B. Install guards on thermostats in all classrooms.

C. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

D. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."

E. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

3.2 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."

1. All Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.

4. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
4. Test each point through its full operating range to verify that safety and operating control set points are as required.
5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
6. Test each system for compliance with sequence of operation.
7. Test software and hardware interlocks.

C. DDC Verification:

1. ATC contractor shall revise the BMS system graphics as required to reflect the new changes in the configuration of the controls in the project area.
2. Verify that instruments are installed before calibration, testing, and loop or leak checks.
3. Check instruments for proper location and accessibility.
4. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
5. Check instrument tubing for proper fittings, slope, material, and support.
6. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
7. Check temperature instruments and material and length of sensing elements.
8. Check control valves. Verify that they are in correct direction.
9. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
10. Check DDC system as follows:

a. Verify that DDC controller power supply is from emergency power supply, if applicable.
b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
c. Verify that spare I/O capacity has been provided.
d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.4 SEQUENCE OF OPERATION

A. These specifications assume that the existing building management system shall provide a schedule for occupied and unoccupied mode. These specifications also assume that the existing exhaust fans service this area of the building are operating at full volume during occupied mode, and are turned off during unoccupied mode. All of the existing base bldg operational equipment serving the project area is assumed to not being changed or being revised. This project consists of replacing existing air-handling unit equipment and installing a few new reheat coils. If the contractor finds differently, he is to notify the Engineer before proceeding with his work.

B. Air Handling Unit (AC-17 and AC-18):

1. AHU's shall operate constant volume continuously during Occupied hours as directed by the CCRI BMS control system to provide heating, cooling and ventilation to the Physics department classrooms, conference rooms and support offices.
2. During occupied mode, the fan shall run continuously. Upon a call for cooling, the chilled water control valve shall modulate open to maintain a space temperature set-point of 75°F (adjustable) as averaged by the various thermostats in the area of scope of this project or discharge air temperature as is presently configured by the CCRI BMS system. When the space temperature set-points are satisfied, the chilled water control valve shall close.
3. During unoccupied mode, the fan shall index upon a call for cooling or heating. If the average temperature of the associated spaces calls for cooling or if a single space calls for heating, the fan shall be energized. The fan shall be de-energized if all temperature set-points are satisfied.

C. Hot Water Reheat Coils (Classrooms, Conference Rooms, and support Offices):

1. The hot water control valves shall modulate to maintain a space temperature of 70°F (adjustable) as sensed by the associated wall mounted sensor.

D. Motorized Dampers:
1. During occupied mode, the outdoor air motorized damper shall open to set position and the return air dampers shall close to the minimum position as indicated on plan.
2. During the unoccupied mode,

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 23 21 13 – HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hot-water heating piping.
2. Chilled-water piping.
3. Condensate-drain piping.

1.2 SUBMITTALS

A. Product Data: For each type of the following:

1. All pipe and fittings.
2. Pressure-seal fittings.
3. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
4. Air control devices.
5. Chemical treatment.
6. Hydronic specialties.

B. Shop Drawings: Detail, at minimum ¼”=1’-0” scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.3 HOT WATER COILS

A. Coil will be designed with aluminum or copper plate fins and copper/copper alloy tubes. Fins have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. Coil has airflow arrow and nameplate attached to coil casing. Coil is certified in accordance with the AHRI Forced-Circulation Air-Cooling and Air-Heating Coils Certification Program which is based on AHRI Standard 410 within the Range of Standard Rating Conditions listed in Table 1 of the Standard.

B. The coil shall be a single-row serpentine coil, with 5/8" [16mm] OD tubes. Coil has a supply header to ensure distribution of hot water to each tube of coil. Coil is proof tested at a minimum of 300 psig [2068kPa] and leak tested to 200 psig [1379kPa], air pressure under water. Working pressure is maximum 200 psig [1379kPa] at 220F [104C].

C. Coil casing is manufactured with galvanized steel.

D. Aluminum plate fin is based on Trane PRIMA FLO H (Hi-Efficient) fin design or approved equal.

E. Coil supply connection is shall be based on drawings and actual field conditions.

1.4 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

B. To assure uniformity and compatibility of piping components in grooved piping systmes, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be supplied from the same manufacturer as the grooved components.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Wrought-Copper Fittings: ASME B16.22.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Anvil International, Inc.
   b. S. P. Fittings; a division of Star Pipe Products.
   c. Victaulic Company of America.

3. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting with copper tube dimensioned grooved ends (flaring of tube and fitting ends to IPS dimensions is not permitted).
4. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated Grade EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.

E. Wrought-Copper Unions: ASME B16.22.

2.2 PLASTIC PIPE AND FITTINGS

A. CPVC Plastic Pipe: ASTM F 441/F 441M, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.

B. CPVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM F 438 for Schedule 40 pipe; ASTM F 439 for Schedule 80 pipe.

C. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.

D. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Solvent Cements for Joining Plastic Piping:

1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Charlotte Pipe and Foundry Company.
b. IPEX Inc.
c. KBi.

3. PVC one-piece fitting with one threaded brass or copper insert and one Schedule 80 solvent-cement-joint end.

B. Plastic-to-Metal Transition Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Charlotte Pipe and Foundry Company.
   b. IPEX Inc.
   c. KBi.
   d. NIBCO INC.

3. MSS SP-107, CPVC and PVC union. Include brass or copper end, Schedule 80 solvent-cement-joint end, rubber gasket, and threaded union.

2.5 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Capitol Manufacturing Company.
   b. Central Plastics Company.
   c. Hart Industries International, Inc.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.

3. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Couplings:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Calpico, Inc.
   b. Lochinvar Corporation.

3. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

2.6 VALVES

A. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

B. Bronze, Calibrated-Orifice, Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong Pumps, Inc.
    b. Bell & Gossett Domestic Pump; a division of ITT Industries.
    c. Flow Design Inc.
    d. Gerand Engineering Co.
    e. Griswold Controls.
    f. Taco.
    g. Tour & Andersson

3. Body: Bronze, ball or plug type with calibrated orifice or venturi.
4. Ball: Brass or stainless steel.
5. Plug: Resin.
6. Seat: PTFE.
7. End Connections: Threaded or socket.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. Multiple-turn digital readout handwheel and concealed memory feature with locking, tamper-proof setting.
11. CWP Rating: Minimum 125 psig.
12. Maximum Operating Temperature: 250 deg F.

2.7 AIR CONTROL DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Spirotherm – No Exceptions

C. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

2.8 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 60 mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

B. EPDM Bellow, Flexible Connectors are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

C. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Chilled-water piping, aboveground, NPS 2 and smaller, shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

C. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be any one of the following:

1. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

D. Chilled-Water Piping Installed Belowground and within Slabs: Type K, annealed-temper copper tubing, wrought-copper fittings, and soldered or brazed joints. Use the fewest possible joints.

E. Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

3.2 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing and throttling duty valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

Q. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

R. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 3/8 inch.
3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 1/2 inch.
7. NPS 3: Maximum span, 12 feet; minimum rod size, 1/2 inch.
8. NPS 3-1/2: Maximum span, 13 feet; minimum rod size, 1/2 inch.
9. NPS 4: Maximum span, 14 feet; minimum rod size, 5/8 inch.

E. Install hangers for drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet\; minimum rod size, 3/8 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 3/8 inch.
3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 1/2 inch.
7. NPS 3: Maximum span, 10 feet; minimum rod size, 1/2 inch.

F. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

G. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.6 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
3. PVC Pressure Piping: Join ASTM D 1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D 2855.
4. PVC Nonpressure Piping: Join according to ASTM D 2855.

H. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

3.7 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

C. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.

D. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.

E. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.

1. Install tank fittings that are shipped loose.
2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

3.8 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.10 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.

4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION

SECTION 23 31 13 – METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.
2. Round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.
6. Seismic-restraint devices.

B. Related Sections:

1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
3. Division 23 Section "Vibration and Seismic Control for HVAC Piping and Equipment" for vibration and seismic control requirements.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. All supply and return air ductwork connected to the air-handling units and routed in the main corridors shall be constructed using SMACNA Medium Pressure Duct Standards.

C. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems".

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

D. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in the most current version of ASHRAE 62.1.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

D. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Structural members to which duct will be attached.
3. Size and location of initial access modules for acoustical tile.
4. Penetrations of smoke barriers and fire-rated construction.

E. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports, AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports or AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Square throat round heel elbows are not acceptable.

2.2 ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Lindab Inc.
b. McGill AirFlow LLC.
c. SEMCO Incorporated.
d. Sheet Metal Connectors, Inc.
e. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for

static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger Than 90 inches in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Refer to Specification Section 230548 for any more stringent requirements.

B. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

C. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

D. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

E. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

F. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

G. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

H. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

I. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.6 SEISMIC-RESTRAINT DEVICES

A. Refer to Specification Section 230548 for any more stringent requirements.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Ductmate Industries, Inc.
3. Hilti Corp.
4. Kinetics Noise Control.
5. Loos & Co.; Cableware Division.
6. Mason Industries.
7. TOLCO; a brand of NIBCO INC.
8. Unistrut Corporation; Tyco International, Ltd.

C. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction].

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

D. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

E. Restraint Cables: ASTM A 492, stainless-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod.

G. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct

systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Exhaust ductwork shall be welded steel.

F. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

G. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

I. Install ducts with a clearance to adjacent surfaces of 1 inch, plus allowance for insulation thickness.

J. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

K. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

L. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

M. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."]

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
2. Brace a change of direction longer than 12 feet (3.7 m).

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 DUCT CLEANING

A. Clean all new and existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies. This shall apply to new or existing fans being used or connected to as part of this project.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.8 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Underground Ducts: Concrete-encased, PVC-coated, galvanized sheet steel with thicker coating on duct exterior or stainless steel.

B. Supply Ducts:

1. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive 4-inch wg.

C. Return Ducts:

1. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 3-inch wg.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting Air:

a. Pressure Class: Positive 3-inch wg.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
2) Mitered Type RE 4 with vanes.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

   a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
   b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
   c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

   a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

      1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      4) Radius-to Diameter Ratio: 1.5.

   b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
   c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."

   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.

   a. Velocity 1000 fpm or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm: Conical tap.
   c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Manual volume dampers.
2. Control dampers.
3. Fire dampers.
4. Smoke dampers.
5. Flange connectors.
6. Turning vanes.
7. Duct-mounted access doors.
8. Flexible connectors.
9. Duct accessory hardware.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control damper installations.
d. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
e. Wiring Diagrams: For power, signal, and control wiring.

C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Exposed-Surface Finish: Mill phosphatized.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Air Balance Inc.; a division of Mestek, Inc.
   b. McGill AirFlow LLC.
   c. Nailor Industries Inc.
   d. Ruskin Company.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:

   a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized-steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.
7. Tie Bars and Brackets: Galvanized steel.

B. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.3 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Ruskin Company.
4. Young Regulator Company.

B. Frames:

1. Angle shaped.
2. Galvanized-steel channels, 0.064 inch thick.
3. Mitered and welded corners.

C. Blades:

1. Multiple blade with maximum blade width of 8 inches.
2. Opposed-blade design.
3. Galvanized steel.
4. 0.064 inch thick.
5. Blade Edging: Closed-cell neoprene edging.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

D. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

2.4 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc.
4. Ruskin Company.

B. Type: Dynamic Out of Airstream; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.

D. Fire Rating: 1-1/2 and 3 hours (as required for wall rating).

E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

K. Heat-Responsive Device: Electric resettable link and switch package, factory installed, 165 deg F rated.

2.5 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. Nailor Industries Inc.
4. Ruskin Company.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Smoke Detector: Integral, factory wired for single-point connection.

D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.

E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

F. Leakage: Class I / Class II (as required for assembly).

G. Rated pressure and velocity to exceed design airflow conditions.

H. Mounting Sleeve: Factory-installed, 0.052-inch- thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

I. Damper Motors: two-position action.

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.

5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

K. Accessories:

1. Auxiliary switches for signaling, fan control, or position indication.
2. Momentary test switch, Test and reset switches, damper remote mounted.

2.6 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.7 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

E. Vane Construction: Single and Double wall.

F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.8 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Greenheck Fan Corporation.
3. McGill AirFlow LLC.
4. Nailor Industries Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 10-inch wg.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.9 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.

D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.10 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd..
2. Minimum Tensile Strength: 500 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.11 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream from turning vanes.
9. Control devices requiring inspection.
10. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 12 by 12 inches.
2. Two-Hand Access: 12 by 12 inches.
3. Head and Hand Access: 18 by 12 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 30 by 30 inches.
6. Body plus Ladder Access: 42 by 30 inches.

K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Install duct test holes where required for testing and balancing purposes.

O. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION

SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Diffusers, registers and grilles – All Type.

B. Related Sections:

1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 DIFFUSERS, REGISTERS AND GRILLES

A. Provide diffusers, registers and grilles for supply, return and exhaust outlets, of size, type, construction and design shown on Drawings.

B. Acceptable manufacturers:

1. Krueger
2. Metalaire
3. Price Industries
4. Titus
5. Tuttle & Bailey.

B. Equipment shall be tested and rated per ASHRAE 91-70.

C. Equipment shall handle air quantities at operating velocities:

1. With maximum diffusion within space supplied or exhausted.
2. Without objectionable air movement as determined by Architect and Engineer.
3. With sound pressure level not to exceed NC 25.

E. Supply registers shall have two sets of directional control blades.

F. Diffusers within same room or area shall be of same type and style to provide uniformity.

G. Diffusers, registers and grilles shall be furnished with gaskets and installed with faces set level and plumb, tightly against mounting surface.

H. Diffusers, registers and grilles shall be aluminum construction and painted with white enamel. Finish shall receive final approval from the Architect prior to ordering.

I. Provide all necessary equipment for complete installation, including: lined plenum boxes, frame types, etc. as called for on the drawings.

I. Coordinate diffusers, registers and grilles with ceiling and wall construction. Refer to Architectural Drawings for exact lengths and for framing and mitering arrangements that may differ from those shown on HVAC Drawings.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 73 13 - INDOOR AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Constant air-volume air-handling units for indoor use.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Seismic Performance: Air-handling units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.3 SUBMITTALS

A. Product Data: For each air-handling unit indicated.

1. Unit dimensions and weight.
2. Cabinet material, metal thickness, finishes, insulation, and accessories.
3. Fans:

   a. Certified fan-performance curves with system operating conditions indicated.
   b. Certified fan-sound power ratings.
   c. Fan construction and accessories.
   d. Motor ratings, electrical characteristics, and motor accessories.

4. Certified coil-performance ratings with system operating conditions indicated.
5. Dampers, including housings, linkages, and operators.
6. Filters with performance characteristics.

B. Delegated-Design Submittal: For vibration isolation and seismic restraints indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

C. Seismic Qualification Certificates: For air-handling units, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Source quality-control reports.

E. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

E. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aaon.
2. Carrier Corporation.
3. Haakon.
4. McQuay International
5. Trane; American Standard Inc.

B. Substitute equipment may be considered for approval that includes at a minimum:

1. ECM driven direct drive backward curved plenum supply fans
2. Double wall cabinet construction
3. Insulation with a minimum R-value of 6.25
4. Double sloped stainless steel drain pans
5. Hinged access doors with lockable handles
6. Designed, engineered, and manufactured in the United States of America
7. All other provisions of the specifications must be satisfactorily addressed

2.2 GENERAL DISCRIPTION

A. Indoor air handling units shall include filters, supply fans, chilled water coil, and unit controls.

B. Unit shall have a draw-through supply fan configuration and discharge air horizontally.

C. Unit shall be factory assembled and tested including leak testing of the chilled water coil, and run testing of the supply fans and factory wired electrical system. Run test report shall be supplied with the unit.

D. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.

E. Unit components shall be labeled, including pipe stub outs, electrical and controls components.

F. Installation, Operation and Maintenance manual shall be supplied within the unit.

G. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.

H. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

2.3 CONSTRUCTION

A. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.

B. Unit insulation shall have a minimum thermal resistance R-value of 6.25. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.

C. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.

D. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

E. Access to filters, cooling coil, supply fans, and electrical and controls components shall be through hinged access doors.

F. Access doors shall be flush mounted to cabinetry. Coil access door and supply fan access door shall include quarter-turn lockable handles. Supply fan access door shall include removable pin hinges.

G. Units with a cooling coil shall include sloped 304 stainless steel drain pan. Drain pan connection shall be on the right hand side of unit.

H. Cooling coil shall be mechanically supported above the drain pan by multiple supports that allow drain pan cleaning and coil removal.

2.4 ELECTRICAL

A. Unit shall be provided with an external control panel with separate low voltage control wiring with conduit and high voltage power wiring with conduit between the control panel and the unit. Control panel shall be field mounted.

B. Unit shall be provided with standard power block for connecting power to the unit.

C. Unit shall include a factory installed 24V control circuit transformer.

2.5 SUPPLY FANS

A. Unit shall include direct drive, unhoused, backward curved, plenum supply fans.

B. Blower and motor assembly shall be dynamically balanced.

C. Blower and motor assembly shall be isolated with neoprene gasket.

D. Motor shall be a high efficiency electronically commutated motor (ECM).

E. ECM driven supply fan cfm setpoint shall be set with factory installed potentiometer within the control compartment.

2.6 COOLING COIL

A. Chilled Water Cooling Coil

1. Coil shall be certified in accordance with AHRI Standard 410 and be hydrogen or helium leak tested.
2. Coil shall be constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.
3. Coil shall have single serpentine circuitry, 4 rows and 12 fins per inch.
4. Coil shall have right hand external piping connections. Supply and return connections shall be sweat connection. Coil connections shall be labeled, extend beyond the unit casing, and be factory sealed on both the interior and exterior of the unit casing, to minimize air leakage.

2.7 FILTERS

A. Unit shall include 2 inch thick, pleated panel filters with an ASHRAE efficiency of 30% and MERV rating of 8, upstream of the cooling coil.

B. Unit shall include a clogged filter switch.

2.8 CONTROLS

A. Unit shall be provided with an external control panel with separate low voltage control wiring with conduit and high voltage power wiring with conduit between the control panel and the unit. Control panel shall be field mounted.

B. Unit shall be provided with a terminal block for field installation of controls.

2.9 SOURCE QUALITY CONTROL

A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

C. Water Coils: Factory tested to 300 psig according to ARI 410 and ASHRAE 33.

D. Refrigerant Coils: Factory tested to 450 psig according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting: Install air-handling units on concrete bases using springs or pad selected and sized by Mason Industries. Secure units to anchor bolts installed in concrete bases. Comply with requirements for concrete bases specified in Division 03 Section "Cast-in-Place Concrete." Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
   1. Install galvanized steel plate to equally distribute weight over elastomeric pad.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
   3. Install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Arrange installation of units to provide access space around air-handling units for service and maintenance.

D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

E. Install filter-gage, static-pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum in accessible position. Provide filter gages on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

F. Comply with requirements for piping specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

G. Install piping adjacent to air-handling unit to allow service and maintenance.

H. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.

I. Connect condensate drain pans using ASTM B 88, Type M copper tubing (size shown on drawings). Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

J. Chilled-Water Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

K. Connect duct to air-handling units with flexible connections. Comply with requirements in Division 23 Section "Air Duct Accessories."

END OF SECTION

SECTION 26 00 00 - GENERAL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Work that applies to all sections of DIVISION 26
2. Temporary electrical wiring
3. Removals (demolition) and relocations
4. Utility company incentives applications

1.2 RELATED DOCUMENTS

A. The General Conditions, Supplementary Conditions, and applicable portions of Division 1 of the specification are part of Division 26, 27 and 28 which shall consist of all labor, equipment, materials and other costs necessary to complete all ELECTRICAL MATERIALS AND METHODS work indicated on the drawings, herein specified or both.

1.3 RELATED WORK SPECIFIED UNDER OTHER SECTIONS: Read these DIVISIONS carefully. For purposes of bidding, assume that all work of the DIVISION referenced is to be performed under that DIVISION unless specifically indicated therein to be performed under the ELECTRICAL DIVISION. Refer to the Architects Specification on drawings for division specification sections not included in this specification.

A. Cutting and patching - see DIVISION 1

B. Allowances – see DIVISION 1.

C. Concrete - see DIVISION 3.

D. Door Hardware - see DIVISION 8.

E. Access panels - see DIVISION 8.

F. Painting of all backboards (on all sides and edges before mounting); painting of panels (trims and doors - 2 coats before mounting); painting of exposed electrical raceways, boxes and fittings - see DIVISION 9.

G. Sprinkler flow switches and gate valve switches - see DIVISION 21.

H. Temperature controls, temperature control wiring, interlock wiring, and boiler control wiring (except as indicated on the electrical drawings) - see DIVISION 23.

1.4 DEFINITIONS

A. Provide: Furnish and install.

B. Wiring: Wire, raceways, boxes and fittings.

1.5 PERMITS AND FEES

A. Obtain all permits for the work of this section

B. Pay all fees, including a FIRE ALARM REVIEW FEE and FINAL INSPECTION FEES.

1.6 SUBMITTALS

A. Product Data: For each product indicated

B. Shop Drawings: Wiring and connection diagrams

C. Manufacturers: Where the drawings or specifications list specific brands or catalog numbers, only these products may be used unless the words: “or approved equal” or “but are not limited to” are included.

D. Limitations of approval: The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Engineer's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Engineer in writing of such deviation, in a separate cover letter on Contractor's letterhead, at the time of submittal and the Engineer has given written approval to the specific deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Engineer's approval thereof.

E. Contractor’s responsibility: It is the responsibility of the Contractor to check all dimensions and details on shop drawings, <u>before</u> <u>submission</u> to the Engineer, reject same if necessary and only forward to the Engineer shop drawings which he is reasonably certain fulfill the requirements of the contract documents and the work. The approval of shop drawings by the Engineer shall be general only in character and not mean dimensions on drawings have been checked, and will in no way relieve the Contractor of the responsibility for proper fitting and construction of the work, nor from the necessity of furnishing materials or doing the work required by the drawings and/or specifications, which may not be indicated on the shop drawings when approved. All shop drawings shall be checked by the Contractor, and <u>must bear</u> the Contractor’s stamp of approval; drawings <u>submitted without</u> this stamp of approval <u>will not be considered</u>.

F. Samples: Provide all samples requested by the Engineer.

G. Tests: Test the complete installation to prove it free from shorts, grounds, opens and faulty connections. Make any corrections necessary before acceptance.

1. Test each function of each system including each device.

H. Certification: Upon request, provide "Certification" (by a recognized testing agency or a Professional Engineer registered in the state where the project is located) that submitted items of equipment are suitable for their intended use.

I. Record of Addenda and Change Orders<u>:</u> To avoid overlooking addenda and change order modifications, mark all changes on all copies of drawings and specifications, in a manor acceptable to the Engineer. One method of accomplishing this is to make copies and tape them on the back of the preceding page (tape all edges). Also, circle the changed area and note: see addenda #1, etc. If whole pages or sheets change, either remove the superseded document or put a bold "X" through it.

J. Record Drawings: Owner's record drawings shall be updated as the project progresses. Maintain documents in a safe, dry location. Indicate clearly and accurately any changes necessitated by field conditions and dimension all raceways built into or under concrete slabs or buried under ground.

K. Operating Instructions and Manuals: Provide the Owner or his representative with complete operating instructions by qualified personnel of all electrical systems. Provide three (3) bound sets (indexed and bound in three sturdy three-ring binders) of operating and maintenance instructions of all electrical systems employed and all shop final approved drawings.

L. Manuals: Provide one (1) extra bound set of all shop drawings. Bind in a sturdy 3-ring binder.

M. Letter of Confirmation: Include in the above manuals a letter confirming that the following items have been completed. Provide written receipt signed by the Owner or his representative indicating that the first 4 items listed below have been received.

1. The number of circuit breaker locks called for have been provided.
2. Keys have been provided for all locked electrical equipment.
3. The provisions of the "Operating Instructions and Manuals" paragraph of these specifications have been met.
4. Spare fuses have been provided.
5. Identification is complete and in accordance with these specifications.
6. As-built electrical drawings have been completed and submitted.
7. All tests are complete and in accordance with these specifications.
8. All required shop drawings have been submitted and approved.
9. The entire installation has been accepted by all authorities.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Do all wiring and provide all equipment in accordance with the prevailing issue of the National Electrical Code, State Building Code, State Fire Code, OSHA and any additional local rules or requirements.

C. Obtain and pay for all necessary permits, certificates, reviews, etc. Present satisfactory proof of final inspection and approval by all inspection authorities.

D. Consider the most current edition (as of the date of this specification) of the following Industry Standards as minimum requirements for all materials, equipment and systems where such standards are established for materials in question:

1. National Board of Fire Underwriters
2. National Electrical Manufacturers Association
3. National Fire Protection Association
4. Institute of Electrical and Electronic Engineers
5. Local Electric Utility Company
6. Local Telephone Company
7. A nationally recognized testing laboratory (UL, ETL, etc.)
8. Factory Mutual
9. Americans with Disabilities Act

10. American National Standards Institute
11. TIA/EIA
12. BICSI TDDM

E. Where applicable, this installation shall comply with the most recent edition of the following NECA (National Electrical Contractors Association) "National Electrical Installation Standards." Except, if there is a conflict between this specification and these standards, the requirements of this specification shall prevail.

1. NECA 1 Standard Practices for Good Workmanship in Electrical Contracting
2. NECA 101 Standard for Installing Steel Conduit (Rigid, EMT)
3. NECA/AA 104 Recommended Practice for Installing Aluminum Building Wire and Cable
4. NECA 400 Recommended Practice for Installing and Maintaining Switchboards
5. NECA/IESNA 500 Recommended Practice for Installing Indoor Commercial Lighting Systems
6. NECA/BICSI 568(B)Telecommunications

1.8 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings for electrical supports, raceways, and cable with general construction work.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment that requires positioning before closing in the building.

C. Coordinate electrical service connections to components furnished by utility companies.

D. Electrical Contractor shall review that portion of submittals from other Divisions which effects the electrical equipment and adjust the sizing of conductors, conduits and over current protection devices according to substitutions made. Monetary settlement for such substitutions shall be between Electrical Contractor and the party making the substitution.

1.9 TEMPORARY ELECTRICAL WIRING:

A. The general contractor shall be responsible for all costs associated with energy usage during construction.

B. Provide all required connections, panels, circuit breakers, feeders, branch circuit wiring, transformers, lighting fixtures, lamps, receptacles, switches, etc. for a complete and operating temporary electrical system.

C. Provide a minimum of 10 footcandles of temporary general illumination throughout the floor area of the building, including all corridors and stairways.

D. Existing lighting may be used where it is sufficient and remains energized.

E. Provide feeders of sufficient capacity for the requirements of the work, sufficient number of outlets conveniently located so that extension cords not exceeding 100 feet will reach all work requiring artificial light or power.

F. All receptacles must be GFCI protected and the entire installation must comply with all applicable OSHA requirements.

G. At the end of the day's work, disconnect all lights and power, other than the minimum required security illumination.

H. Provide replacement light bulbs and maintenance of the temporary wiring system, as required, throughout the period of construction.

I. Conform to all codes and regulations.

1.10 CHANGE ORDERS/PROPOSAL REQUESTS:

A. Refer to DIVISION 1 of these specifications and add the following:

B. During the course of construction, changes in the work may occur. When a significant change is to be made, a Proposal Request will be issued.

C. Provide a complete cost breakdown when responding to each Proposal Request.

D. Each item of work to be priced separately.

E. Each line item to be broken down including quantities and listing separately labor and material.

F. Both credits and extras shall be separately and clearly quantified.

G. Allowances for overhead and profit shall be as listed in the supplementary conditions.

H. If you become aware of a field condition, code requirement, error, or omission that you feel should result in a change to the work, please contact the Engineer for discussion. The Engineer may be able to clarify the situation and avoid unnecessary paperwork.

1.11 INSPECTIONS/SITE OBSERVATIONS

A. The authority having jurisdiction (usually the Municipal Electrical Inspector) shall be notified at periodic intervals that an inspection is requested. Inspections shall be requested at points of progress, meeting the approval of the inspector and as a minimum include the following:

1. Prior to enclosing walls.
2. Prior to enclosing ceilings.
3. Prior to installation of panel panel/switchgear trims/covers.
4. For observation of connections and grounding at switchboards, transformers and generators.

B. Do not cover the work before the Engineer has had a chance to observe it in completed form. The electrical foreman shall request a meeting with the Engineer within 10 days after the start of electrical construction to assure that there is agreement on the scope of work and to answer questions.

C. The electrical foreman shall provide assistance to the Engineer during site observations:

1. Describe the progress of the electrical work in detail.
2. Accompany the Engineer on his tour of the site, upon request.
3. Provide use of a suitable ladder, scaffolding or bucket truck to observe the work, upon request.
4. Remove ceiling tiles, panel trims, junction box covers, etc. for observation of the work, upon request.
5. Provide use of project drawings, specifications and shop drawings.

1.12 GUARANTEES/WARRANTIES:

A. Refer to Division 1 of these specifications and add the following:

B. A minimum warrantee time of ~~one~~ two year from date of acceptance by the Engineer.

C. The Owner reserves the right to make appropriate modifications or extensions of systems and equipment furnished under this contract during the guarantee/warranty period without "voiding" or modifying the guarantee/warranty of equipment and wiring installed under this contract. If manufacturer voids guarantee, it shall not relieve this contractor of his responsibilities for guarantee/warranty period.

1.13 MISCELLANEOUS

A. Provide all systems complete. Drawings and Specifications form complementary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both.

B. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials obviously necessary for a sound, secure and complete installation.

C. All wiring and connections to be done with associated circuit de-energized.

1.14 UTILITY COMPANY INCENTIVES

A. Electrical Contractor shall compile, fill-in, and sign all applicable NGRID lighting and controls incentive applications for this project and turn over completed document package to the General Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS - General:

A. All materials and equipment to be new unless specifically stated otherwise.

B. Materials and equipment shall be suitable for their intended use and for the environment in which they are installed. For example, equipment located outside shall be weatherproof and constructed of materials that will not rust. This includes brackets, screws, etc.

C. Coordinate all dimensions to make sure that boxes, raceways, equipment, fixtures, etc., fit properly in the finished construction. If special provisions, such as shallow boxes, are required, they shall be provided at no increase in contract price, regardless of catalog numbers listed in contract documents or on shop drawings.

D. As it is not practical to enumerate in these specifications (or show on the drawings) all details of fittings and accessory equipment required for proper operation of the various electrical systems herein described, it is understood that they will be supplied without extra compensation. Provide all fittings, terminations, relays, components of panels and equipment, etc., needed for the best performance possible at the present state-of-the-art.

2.2 EQUIPMENT BACKBOARDS

A. Where not otherwise specified, equipment backboards shall be fire rated, exterior grade, AC grade, installed with 'A' side exposed.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components so as to allow for safe personnel movement and maintenance access.

B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

D. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 LAYOUTS

A. The electrical system layouts indicated are generally diagrammatic and locations of outlets and equipment are approximate only. Exact routing of wiring and locations of outlets and equipment shall be governed by structural conditions and obstructions. This is not to be construed to permit redesigning systems. Interconnect as shown.

B. Locate all equipment requiring maintenance and operation so that it will be readily accessible. The right is reserved to make any reasonable change in location of outlets and equipment prior to roughing-in without involving additional expense. This may involve slightly longer wiring runs, longer stems, additional mounting provisions, etc. Allow for this in your bid because additional compensation will not be provided. Items not specifically located on the plans shall (for the purposes of bidding) be assumed to be in the farthest, most difficult location. Exact location to be as directed in the field.

3.3 ELECTRICAL SERVICE:

A. Service to be as indicated on the drawings.

3.4 ELECTRICAL SUPPORTING DEVICE APPLICATION

A. Damp Locations and Outdoors: Hot-dip galvanized materials, slotted channel system components.

B. Dry Locations: Steel materials.

C. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four with, 200-lb (90-kg) minimum design load for each support element.

3.5 SEQUENCE AND BALANCE:

A. Maintain correct phase sequence of all feeders and circuits by establishing phase identification and maintaining correct relationship throughout the system. Provide line balance within 10% of normal loads.

3.6 FIRESTOPPING

A. Refer to Division 7 of these specifications and add the following:

B. Apply firestopping to cable and raceway sleeves and other penetrations of fire-rated floor and wall assemblies to restore original undisturbed fire-resistance ratings of assemblies.

C. Penetrations through exterior surfaces shall be made watertight.

D. Floor boxes, fed from floor below, shall be fire-rated, poke-through type with UL labeled fire rating to match floor rating.

3.7 WORK INTERFERING WITH EXISTING WIRING:

A. Make any necessary re-circuiting, extensions of existing circuits and relocations required to properly re-energize remaining existing devices or equipment that may be interfered with by new construction or removals.

3.8 CUTTING AND PATCHING

A. Refer to Division 1 of these specifications and add the following:

B. This trade (specification section) is responsible for its respective cutting and patching.

C. Do not endanger any work by cutting or altering work or any part of it.

D. Do not cut or alter work of another Contractor without written consent of the Engineer.

E. Prior to cutting which affects structural safety of project, or work of another Contractor, submit written notice to the Engineer, requesting consent to proceed with cutting.

F. Perform all work of fitting, adjustment, cutting, patching, finishing and restoration to perfectly match the quality as specified throughout these specifications. Painting, under DIVISION 9, shall match and be feathered into adjacent surfaces.

3.9 CORE DRILLING:

A. Refer to Division 1 of these specifications and add the following:

B. All holes through masonry surfaces must be "core drilled". This trade (specification section) is responsible for its respective core drilling, if any.

C. Do not endanger any work by drilling or altering work or any part of it.

D. Do not drill or alter work of another Contractor without written consent of the Engineer.

E. Prior to drilling which affects structural safety of project, or work of another Contractor, submit written notice to the Engineer, requesting consent to proceed with cutting.

F. Perform all work of core drilling to perfectly match the quality as specified throughout these specifications.

3.10 ACCESS PANELS:

A. Refer to Division 8 of these specifications and add the following:

B. This trade (specification section) is responsible for determining the number of access panels required for existing and new electrical work (including one under each above ceiling thermodetector) and furnishing them to the mason or drywall contractor for installation.

3.11 CLEANING, PAINTING AND REFINISHING:

A. Refer to Division 1 of these specifications and add the following:

B. Paint all new plywood backboards on all sides and edges before mounting, under DIVISION 9.

C. Thoroughly clean all new electrical equipment, devices and enclosures upon completion of all work.

D. Refinish any new electrical equipment whose finish is damaged or rusted, as determined by the Engineer.

END OF SECTION

SECTION 26 05 19 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70.

B. Conductor Insulation: Comply with NEMA WC 70 for Types THW, THHN-THWN and XHHW.

C. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.
6. Thomas & Betts

C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. All conductors shall be copper.

B. At terminations of devices, provide solid conductor in sizes #10 and smaller; stranded wire may be used with fork type crimp connectors or with clamp type termination on the device. Do not wrap stranded wire under screw heads. Do not use back wired devices with spring type connection.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

D. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway or Metal-clad cable, Type MC.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section 260548 "Vibration and Seismic Controls."

F. Identify and color-code conductors and cables according to Division 26 Section 260553 "Identification."

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

3.4 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 7 Section "Through-Penetration Firestop Systems."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test the emergency system and conductors for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors shall conform to ASTM B3 and B8 as applicable.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, listed for use.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 4/0 AWG minimum. Bury at least 24 inches (600 mm) below grade.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors in all circuits.

B. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Bond conductor to heater units, piping, connected equipment, and components.

C. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service or at isolated ground bar in panelboard.

D. Coordinate paragraph and subparagraphs below with Drawings and Sections for signal and communication equipment.

E. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each Telecommunications Main Ground Bar (TMGB), and from the TMGB to each Telecommunications Ground Bar (TGB). Provide No. 6

AWG minimum insulated grounding conductor from TGB to each terminal cabinet, rack, or equipment.

1. Service Locations: Terminate grounding conductor on a TMGB.
2. Equipment Locations and Wiring Closets: Terminate grounding conductor on a TGB.
3. Terminal Cabinets, Rack or Equipment: Terminate grounding conductor on grounding terminal.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.

a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
b. Perform tests by fall-of-potential method according to IEEE 81.

B. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 29 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.3 SUBMITTALS

A. Product Data: For steel slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Equipment supports.

C. Welding certificates

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. ERICO International Corporation.
   d. GS Metals Corp.
   e. Thomas & Betts Corporation.
   f. Unistrut; Tyco International, Ltd.
   g. Wesanco, Inc.
   h. Power Strut
3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
6. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
2. Mechanical-Expansion Anchors: Insert-wedge-type, [zinc-coated] [stainless] steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.

3) Hilti Inc.
4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 5 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity (weight bearing and raceway / cable accommodation) exceeds the current need by 25%.

1. Secure raceways and cables to these supports with conduit clamps listed for the use.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69, or Spring-tension clamps.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 5 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

END OF SECTION

SECTION 26 05 33 - RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. See Division 2 Section "Underground Ducts and Utility Structures" for exterior ductbanks and manholes, and underground handholes, boxes, and utility construction.

1.2 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1.

B. IMC: ANSI C80.6.

C. EMT: ANSI C80.3.

D. FMC: Zinc-coated steel.

E. LFMC: Flexible steel conduit with PVC jacket.

F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Steel, set-screw type or compressed type.

2.2 NONMETALLIC CONDUIT AND TUBING

A. ENT: NEMA TC 13.

B. RNC: NEMA TC 2, Type EPC-40-PVC unless otherwise indicated.

C. LFNC: UL 1660.

D. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

E. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

C. Description: For indoor applications sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated. For outdoor applications, stainless steel, sheet metal sized and shaped as indicated, NEMA 250, Type 3R, with stainless steel hardware, unless otherwise noted.

D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

E. Wireway Covers: Screw-cover type

F. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

D. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

E. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.

F. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit, EMT, RNC, Type EPC-80-PVC.
2. Concealed Conduit, Aboveground: Rigid steel conduit, EMT
3. Underground Conduit: RNC, Type EPC-40-PVC, with 3” of concrete on all sides.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Concealed in Ceilings and Interior Walls and Partitions: EMT.

3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
4. Damp or Wet Locations: Rigid steel conduit or Schedule 80.
5. Raceways for Optical Fiber or Communications Cable: EMT.
6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Electrical Supports and Seismic Restraints."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

G. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.

H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

I. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

J. Raceways for Optical Fiber and Communications Cable: Install as follows:

1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

K. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

L. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures,] equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

M. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

N. Set metal floor boxes level and flush with finished floor surface.

3.3 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

END OF SECTION

SECTION 26 05 53 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for conductors.
2. Warning labels and signs.
3. Instruction signs.
4. Equipment identification labels.

1.2 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

PART 2 - PRODUCTS

2.1 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

2.2 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

D. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.3 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a black background. Minimum letter height shall be 3/8 inch.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 9 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Apply identification devices to surfaces that require finish after completing finish work.

C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Optional Standby Power.
2. Power.

B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for all conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 10 AWG.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.
4) Neutral: White
5) Ground: Green

6) Isolated Ground: Green with trace ID

c. Colors for 480/277-V Circuits

1) Phase A: Brown
2) Phase B: Orange
3) Phase C: Yellow
4) Neutral: Gray
5) Ground: Green

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

C. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power:

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

a. Power transfer switches.
b. Controls with external control power connections.

D. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

E. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch high letters for emergency instructions at equipment used for power transfer or load shedding.

F. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high.

END OF SECTION

SECTION 26 05 73 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.

1. Coordination of series-rated devices is permitted where indicated on Drawings.

1.3 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals may be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and Equipment Evaluation Reports.
3. Coordination-Study Report.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For coordination-study specialist.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:

1. CGI CYME.
2. EDSA Micro Corporation.
3. ESA Inc.

4. Operation Technology, Inc.
5. SKM Systems Analysis, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.
b. Simultaneous faults.
c. Explicit negative sequence.
d. Mutual coupling in zero sequence.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other electrical Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

a. Circuit-breaker and fuse-current ratings and types.
b. Relays and associated power and current transformer ratings and ratios.
c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
d. Generator kilovolt amperes, size, voltage, and source impedance.
e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
f. Busway ampacity and impedance.
g. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

a. Special load considerations, including starting inrush currents and frequent starting and stopping.
b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
d. Generator thermal-damage curve.
e. Ratings, types, and settings of utility company's overcurrent protective devices.
f. Special overcurrent protective device settings or types stipulated by utility company.
g. Time-current-characteristic curves of devices indicated to be coordinated.
h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.3 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

1. Switchboard bus.
2. Distribution panelboards.
3. Branch circuit panelboards.
4. Transfer Switches.
5. Variable Frequency Drive.
6. Motor Controllers.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 and IEEE 242.

1. Transformers:

a. ANSI C57.12.10.
b. ANSI C57.12.22.
c. ANSI C57.12.40.
d. IEEE C57.12.00.
e. IEEE C57.96.

2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
3. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.4 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
   1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
   2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
   3. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 141 recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:
   1. Device shall not operate in response to the following:
      a. Inrush current when first energized.
      b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
      c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
   2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
   1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
      a. Device tag.
      b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
      c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
      d. Fuse-current rating and type.
      e. Ground-fault relay-pickup and time-delay settings.
   2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
      a. Device tag.

b. Voltage and current ratio for curves.
c. Three-phase and single-phase damage points for each transformer.
d. No damage, melting, and clearing curves for fuses.
e. Cable damage curves.
f. Transformer inrush points.
g. Maximum fault-current cutoff point.

G. Completed data sheets for setting of overcurrent protective devices.

END OF SECTION

SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes Cx process requirements for the following electrical components, systems, assemblies, and equipment:

1. Electrical equipment connected to Normal power systems, including the following:

   a. Motor-controllers (Starters & VFD's).
   b. Transformers.
   c. Secondary service electrical systems.
   d. Distribution and branch-circuit panelboards.
   e. Lightning protection systems.
   f. Grounding systems.

2. Electrical equipment connected to Essential power systems that provide an alternative source of power in the absence of power from the Normal power system, including the following:

   a. Motor-controllers (Starters & VFD's).
   b. Primary and secondary service electrical systems.
   c. Distribution and branch-circuit panelboards.
   d. Lighting protection systems.
   e. Grounding systems.
   f. Generators.
   g. UPS.

3. Controls and instrumentation, including the following:

   a. Equipment monitoring systems.
   b. Energy monitoring and control systems.
   c. Electrical metering and metering system.
   d. Demand response systems.
   e. Lighting control systems.
   f. Security systems.
   g. Fire-alarm systems.
   h. Audio/Visual systems.

4. Systems testing and verification, including Normal and Essential power systems, and transitions from Normal to Essential power systems and back.
5. Systems testing and verification, including Normal and Essential lighting systems, and transitions from Normal to Essential power systems and back.

B. INFORMATION COVERED IN THIS SECTION IS THE RESPONSIBILITY OF THE ELECTRICAL CONTRACTOR AND THEIR SUBCONTRACTORS.

C. General commissioning requirements and CxA responsibilities are described in Division 01 and are therefore not repeated in this Section.

D. LEED RATING SYSTEM

1. In addition to the reports described in this section, this contractor shall prepare and provide any paperwork required to satisfy LEED v2 EA Prerequisite 1, Fundamental Building Systems Commissioning and EA Credit 3, Enhanced Commissioning.

E. Related Requirements:

1. Division 01 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.

1.3 DEFINITIONS

A. BoD: Basis-of-Design Document, as defined in Division 01 "General Commissioning Requirements."

B. Commissioning Plan: A document, prepared by the CxA, that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

C. Cx: Commissioning, as defined in Division 01 "General Commissioning Requirements."

D. CxA: Commissioning Authority, as defined in Division 01 "General Commissioning Requirements."

E. Commissioning Team - The individuals who through coordinated actions are responsible for implementing the commissioning process.

F. Data logging -The monitoring and recording of flows, currents, status, pressures, etc., of equipment using stand-alone data recorders separate from the control system or the trending capabilities of control systems.

G. Deferred Performance Tests (DPTs) - Performance tests that are performed, at the discretion of the CxA, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design, or other site conditions that disallow the test from being performed.

H. Deficiency, Non-Compliance, Non-Conformance - A condition in the installation or function of a component, piece of equipment, or system that is not in compliance with the contract documents.

I. Essential Power Systems: A power system that a facility transitions to in the absence of Normal power. This power includes all systems classified as "standby" or "emergency," including "legally required."

J. Functional Performance Test (FPT) - A protocol written by the CxA that defines methods, personnel, and expectations for tests conducted on components, equipment, assemblies, systems, and interfaces among systems. Performance testing includes the dynamic functions and operations of equipment and systems using manual or monitoring methods under various levels of operation. Systems are tested under various modes, such as during low cooling loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system’s sequences of operation and components are verified to respond as the sequences state.

K. Issues Log - A formal and ongoing record of problems or concerns, and their resolution, that have been raised by members of the commissioning team during the course of the commissioning process.

L. Low Voltage: 600 V and below.

M. Medium Voltage: 601 V and above.

N. Normal Power Systems: A power system that provides primary power to a facility.

O. OPR: Owner's Project Requirements, as defined in Division 01 "General Commissioning Requirements."

P. Official: State or Local official having jurisdiction over the HVAC&R systems

Q. Pre-Functional Testing – testing performed by the contractors to verify system readi**ness.**

R. Quality Assurance: A program for the systematic monitoring and evaluation of the various aspects of a system, assembly, or component to ensure that standards of quality are being met. This is the responsibility of the CxA.

S. Quality Based Sampling - A process for evaluating a sub-set (sample) of the total population. The sample is based upon a known or estimated probability distribution of expected values; an assumed statistical distribution based upon data from a similar product, assembly, or system; or a random sampling that has scientific statistical basis.

T. Quality Control: A system for ensuring the maintenance of proper standards in systems, assemblies, and components. This is the responsibility of the Contractor.

U. Seasonal Performance Tests - Performance tests that are deferred until the system(s) will experience conditions closer to their design conditions based on weather conditions.

V. Startup - The initial starting or activating of dynamic equipment, including completing construction checklists.

W. Systems Manual - A system-focused composite document that includes the operation manual, maintenance manual, and additional information of use to the owner during the occupancy and operations phase.

X. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

Y. Training Plan or Instruction Program - A written document that details the expectations, schedule, and deliverables related to the training of project operating and maintenance personnel, users, and occupants.

Z. Trending – The monitoring, by a building management system or other electronic data gathering equipment, and analyzing of the data gathered over a period of time.

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Division 01 “Submittal Procedures” for specific requirements.

B. Qualification Data: For electrical testing technician.

C. Construction Checklists: Draft construction checklists will be created by CxA for Contractor review.

D. Construction Checklists: Include the following and comply with requirements in Division 01 "Gen-

eral Commissioning Requirements" for construction checklists:

1. Instrumentation and control for electrical systems.
2. Instrumentation and control for lighting control systems.
3. Low-voltage power cables.
4. Control voltage power cables.
5. Electrical feeders and branch circuits.
6. Dry-type transformers.
7. Instrument transformers.
8. Switchgear and switchboard assemblies rated 1000 A or greater.
9. Low-voltage motor starters.
10. Low-voltage surge protective devices.
11. Metering devices.
12. Molded-case circuit breakers.
13. Low-voltage power circuit breakers.
14. Grounding systems.
15. Ground-fault protection systems.
16. Panelboards.
17. Receptacles and devices.
18. Engine generators.
19. Automatic transfer switches.
20. Variable-frequency drives.
21. AC synchronous motors.
22. AC induction motors.
23. DC motors.
24. Battery systems.
25. Battery chargers.
26. UPS systems.
27. Lighting.
28. Audio/Visual System.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electrical systems and components to include in operation and maintenance manuals.

1.6 COORDINATION

A. Coordination of the Cx process is the responsibility of all Cx Team members.

B. The CxA coordinates the commissioning activities through the construction manager or general contractor. All members shall work together to fulfill their contracted responsibilities and meet the objectives of the contract documents.

C. The CxA, through the Owner or CM, will provide sufficient notice to the contractor for scheduling commissioning activities with respect to the Owner’s participation. The CM will integrate all commissioning activities into the overall project schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

D. The electrical contractor shall provide sufficient notice to the CxA for scheduling attendance at all testing activities including duct and pipe pressure testing, and equipment start-up.

1.7 REMOBILIZATION AND RETESTING FEES

A. In general, CxA testing will include one test of each system or equipment. The cost of any additional testing will be submitted to the Owner for review and direction. Following Owner review, the cost for additional testing to verify that performance in accordance with the design intent may be deducted from the Contractor's final payment by the Owner.

B. In the event that a CxA site visit scheduled in advance with the Contractor and testing is unable to be performed through no fault of the Owner and the CxA is not notified within 48 hours prior to the scheduled visit, the cost of the travel and time will be deducted from the contractor's final payment by the Owner.

1.8 QUALITY ASSURANCE

A. Electrical Testing Technician Qualifications: Technicians to perform electrical Construction Checklist verification tests, Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:

1. Journey level or equivalent skill level. Vocational school four-year-program graduate or an Associate's degree in electrical systems, or similar field. Degree may be offset by three years' experience as an apprentice or a journey-level electrician. Generally, required knowledge includes electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of electrical equipment, assemblies, and systems.
2. Minimum 5 years experience installing, servicing, and operating systems manufactured by approved manufacturer.

B. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform electrical Cx work, perform the following:

1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:

   a. Equipment/instrument identification number.
   b. Planned Cx application or use.
   c. Manufacturer, make, model, and serial number.
   d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.

2. Test equipment and instrumentation shall meet the following criteria:

   a. Capable of testing and measuring performance within the specified acceptance criteria.
   b. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
   c. Be maintained in good repair and operating condition throughout duration of use on Project.
   d. Be recalibrated/repaired if dropped or damaged in any way since last calibrated.

C. Proprietary Test Instrumentation and Tools:

1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:

   a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:

      1) Instrument or tool identification number.
      2) Equipment schedule designation of equipment for which the instrument or tool is required.
      3) Manufacturer, make, model, and serial number.
      4) Calibration history, including certificates from agencies that calibrate the instrument or

tool, where appropriate.

b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
c. Electrical proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. The Contractor shall furnish all standard testing equipment required to perform startup, initial checkout and functional performance testing for the equipment being tested. A sufficient quantity of two-way radios shall be provided by each subcontractor FOR USE DURING STARTUP AND TESTING.

B. Refer to Division 01 “General Commissioning Requirements” for a detailed description of test equipment requirements above and beyond that listed herein.

C. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform electrical Cx work, perform the following:

1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:

a. Equipment/instrument identification number.
b. Planned Cx application or use.
c. Manufacturer, make, model, and serial number.
d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.

2. Test equipment and instrumentation shall meet the following criteria:

a. Capable of testing and measuring performance within the specified acceptance criteria.
b. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
c. Be maintained in good repair and operating condition throughout duration of use on Project.
d. Be recalibrated/repaired if dropped or damaged in any way since last calibrated.

D. Proprietary Test Instrumentation and Tools:

1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:

a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:

1) Instrument or tool identification number.
2) Equipment schedule designation of equipment for which the instrument or tool is required.
3) Manufacturer, make, model, and serial number.
4) Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
c. Electrical proprietary test instrumentation and tools become property of Owner at the time of

Substantial Completion.

PART 3 - EXECUTION

3.1 CONSTRUCTION CHECKLISTS

A. Construction Checklists: With assistance from the installing contractors, the CxA will prepare Construction Checklists for all commissioned components, equipment, and systems.

1. Review and provide written comments on draft construction checklists. CxA will create required draft construction checklists and provide them to Contractor.
2. Return draft construction checklist review comments within 10 days of receipt.
3. When review comments have been resolved, the CxA will provide final construction checklists, marked "Approved for Use, (date)."
4. Use only construction checklists, marked "Approved for Use, (date)."
5. The construction checklists, developed by the CxA, are to be completed by this contractor (or its subcontractors), before and during the startup process and verified by the CxA.

3.2 CONSTRUCTION CHECKLIST REVIEW

A. Review and provide written comments on draft construction checklists. CxA will create required draft construction checklists and provide them to Contractor.

B. Return draft Construction Checklist review comments within 10 days of receipt.

C. When review comments have been resolved, CxA will provide final construction checklists, marked "Approved for Use, (date)."

D. Use only construction checklists, marked "Approved for Use, (date)."

3.3 COMMISSIONING TEAM RESPONSIBILITIES

A. Refer to Division 01 Section “General Commissioning Requirements” for commissioning team member roles and responsibilities.

B. The responsibilities of this contractor includes, but is not limited to:

1. Include any costs for Commissioning Process activities in the contract price.
2. Include Commissioning Process requirements and activities in all subcontracts or equipment purchases.
3. Ensure the cooperation and participation of all subcontractors and manufacturers of equipment or systems to be commissioned.
4. Attend Commissioning Team meetings.
5. Include Cx-related milestones in the construction schedule.
6. Implement the training program as described in the Contract Documents. Coordinate related activities with the CxA.
7. Provide submittals to the Owner, Design Team, and CxA as detailed in the Contract Documents.
8. Respond to and resolve issues identified in the Cx Issues Log.
9. Notify the CxA when systems and assemblies are ready for installation verification and testing.

For repetitive assemblies, notify the CxA upon the completion of the prototype for a First Piece or Mock-Up review.

10. Notify the OPM and Architect when duct systems are ready to be pressure tested and assist as required for the testing.
11. Notify the OPM and Architect when systems and equipment is ready for testing, adjusting, and balancing and assist as required.
12. Complete system and equipment checklists developed by the CxA. Complete the Checklists as the work is completed. Provide completed copies to the CxA at regular intervals for verification.
13. Complete Pre-Functional test procedures. Functional testing will not take place until all Pre-functional tests have been fully executed.
14. Functional testing. Once pre-functional tests are complete, functional test verification will be scheduled and demonstrated in the presence of the CxA.
15. Maintain the Project Record Documents in accordance with the requirements of the Contract Documents.

C. The suppliers of major equipment are required to support the Commissioning Team in the following manner:

1. Provide all information required for the proper Start-up and Operation and Maintenance of the system or assembly in the initial submittal, as detailed in the Contract Documents.
2. Provide the requirements to maintain the warranty in the initial submittal, as detailed in the Contract Documents.
3. Coordinate and provide results of all factory tests required in the Contract Documents.
4. Participate in the training process as detailed in the Contract Documents.
5. Demonstrate operation and performance of equipment and assemblies as detailed in the Contract Documents.

3.4 Cx TESTING PREPARATION

A. Certify to the CxA that Electrical systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents based on pre-functional testing having been completed by the Electrical contractor and/or their subcontractors, for each component and system prior to scheduling Cx testing.

B. Certify to the CxA that Electrical instrumentation and control system installation including all components and programming have been completed and calibrated, that they are operating according to the Contract Documents based on pre-functional testing of each sequence, points are set up and are being trended in the BMS, and that pretest set points have been recorded.

C. Certify that testing and adjusting has been completed and that testing and adjusting reports have been submitted, discrepancies corrected, and corrective work completed and approved, and any required rebalancing has been completed.

D. Perform pre-functional testing for all systems and sequences to confirm proper operation of programs and equipment for all operating modes.

E. The contractor shall install testing and measuring instruments and logging devices to record test data as directed by the CxA.

F. If the failure rate of a similar family of equipment or devices is greater than 10%, then the Owner shall be notified. The matter shall be addressed by the Owner, GC, CxA, and other applicable parties. The failure issue shall be resolved to the Owner’s satisfaction.

3.5 GENERAL TESTING REQUIREMENTS

A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating according to the Contract Documents and approved Shop Drawings and submittals.

B. Certify that electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.

C. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

D. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.

E. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.

F. Construction Checklists: Prepare and submit detailed construction checklists for electrical systems, subsystems, equipment, and components.

1. Contributors to development of construction checklists shall include, but are not limited to, the following:

a. Electrical systems and equipment installers.
b. Electrical instrumentation and controls installers.

G. Perform tests using design conditions, whenever possible.

1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.

H. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.

I. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

J. Coordinate schedule with, and perform Cx activities at the direction of the CxA.

K. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance tests requirements specified in Sections specifying electrical systems and equipment.

L. Provide technicians, instrumentation, tools, and equipment to complete and document the following:

1. Performance tests.
2. Demonstration of a sample of performance tests.
3. Cx tests.
4. Cx test demonstrations.

3.6 Cx TESTS FOR ELECTRICAL SYSTEMS

A. Verification of Normal Power System Operation:

1. Prerequisites: Acceptance of results for construction checklists for Division 26 electrical components associated with Normal power system.
2. Equipment and Systems to Be Tested: Division 26 electrical equipment.

3. Test Purpose: Verify operation of Normal power system.
4. Test Conditions: Energize components of Normal power system, one at a time.
5. Acceptance Criteria: Proper operation of Normal power system over a 48 hour period.

B. Verification of Essential Power System Operation:

1. Prerequisites:

a. Acceptance of results for construction checklists for Division 26 electrical components associated with Essential power system.
b. Completion of "Verification of Normal Power System Operation" tests.

2. Equipment and Systems to Be Tested: Division 26 electrical equipment.
3. Test Purpose: Verify operation of Essential power system.
4. Test Conditions:

a. Energize components of Normal power system.

b. Simulate a failure of Normal power system.

5. Acceptance Criteria: Transfer of power from Normal to Essential power system within OPR.

C. Verification of Control and Instrumentation:

1. Prerequisites: Acceptance of results for construction checklists.

a. Section 260923 Lighting Controls Devices
b. Section 262923 Variable-Frequency Drives
c. Section 263213 Engine Generators
d. Section 263353 Static Uninterrutible Power Supply
e. Section 263600 Transfer Switches
f. Section 265300 Networked Lighting Controls

D. Test Purpose: Verify operation of control and monitoring systems for Normal and Essential power systems.

E. Test Conditions:

1. Energize components of Normal power system.
2. Test operation of equipment.

F. Acceptance Criteria: Operation of equipment according to OPR.

3.7 DEFICIENCIES

A. Refer to Division 01 “General Commissioning Requirements” for additional requirements pertaining to deficiencies, non-conforming conditions, cost of retesting, or failure due to manufacturing defects.

3.8 APPROVAL

A. Refer to Division 01 “General Commissioning Requirements” for additional approval procedures.

3.9 DEFERRED TESTING

A. Refer to Division 01 Section “General Commissioning Requirements” for additional requirements pertaining to deferred testing.

3.10 OPERATION AND MAINTENANCE MANUALS

A. Refer to Division 01 Section “General Commissioning Requirements” for additional operation and

maintenance manual requirements.

3.11 TRAINING OF OWNER PERSONNEL

A. Refer to Division 01 Section “General Commissioning Requirements” for additional owner training requirements.

B. The Mechanical Contractor shall provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of mechanical equipment.

1. Provide a training plan to the CxA prior to any training.
2. A training agenda for each training session shall be submitted to the CxA one (1) week prior the training session.
3. The CA shall be notified in advance of scheduled tests so that testing may be observed by the CA and Owner's representative. A copy of the test record shall be provided to the CA, Owner, and Architect.
4. The contractor shall engage a Factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specific equipment.
5. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, trouble shooting, servicing, and maintaining equipment.
6. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of Electrical equipment
7. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation.
8. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system shall be repaired or adjusted as necessary and the demonstration repeated.
9. The Contractor shall provide one or more qualified instructors as appropriate to the equipment or systems. The instructor may be the start-up technician for the piece of equipment, the installing contractor or manufacturer’s representative. The instructor shall possess practical expertise and in-depth knowledge of all modes of operation for each specific piece of equipment.
10. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
11. Training shall include:
    a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
    b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
    c. Discussion of relevant health and safety issues and concerns. Include Material Safety Data Sheets as applicable.
    d. Discussion of warranties and guarantees.
    e. Common troubleshooting problems and solutions.
    f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
    g. Discussion of any peculiarities of equipment installation or operation.
12. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventive maintenance for all pieces of equipment.

13. Training shall occur after functional testing is complete, unless approved otherwise by the Owner.
14. All training sessions with the Owner's personnel shall be professionally digitally video recorded and DVD provided with the O&M manuals.

END OF SECTION

SECTION 26 09 23 - LIGHTING CONTROLS DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Indoor occupancy sensors.

B. Related Sections include the following:

1. Division 26 Section "Network Lighting Controls" for low-voltage, manual and programmable lighting control systems.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 SHALL BE PROVIDED PER DRAWINGS.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Network Lighting Controls."

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

D. Field quality-control reports.

E. Panelboard schedules for installation in panelboards.

F. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: ~~One~~ Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1
b. Outdoor Locations: NEMA 250, Type 4.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Directory Card: Inside panelboard door, mounted in transparent card holder.
5. Type load type and location.

C. Incoming Mains Location: Top and bottom.

D. Phase, Neutral, and Ground Buses: Tin-plated aluminum

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Compression type.
3. Ground Lugs and Bus Configured Terminators: Compression type.
4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer
2. General Electric Company
3. Siemens

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike; hinged door and trim.

D. Branch Overcurrent Protective Devices: Bolt on or Square D I-Line or equal.

2.3 LIGHTING APPLIANCE BRANCH-CIRCUIT TYPE PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer
2. General Electric Company
3. Siemens

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike; door in door hinged trim.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer
2. General Electric Company
3. Siemens
4. Square D

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Where shown on schedules electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long- and short-time time adjustments.
   d. Ground-fault pickup level, time delay, and I^2t response.

4. Where shown on schedules GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (5-mA trip).
5. Where shown on schedules Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
6. Where shown on schedules Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

   a. Standard frame sizes, trip ratings, and number of poles.
   b. Lugs: Compression or Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

d. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Receive, inspect, handle, store and install panelboards and accessories according to NECA 407.

B. Comply with mounting and anchoring requirements specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

D. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

E. Install filler plates in unused spaces.

F. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

G. Arrange conductors in gutters into groups and bundle with tie wraps.

H. Comply with NECA 1.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Electrical Identification."

B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Electrical Identification."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 16 Section "Electrical Identification."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test each panelboard bus, component, connecting supply, feeder, and control circuit for shorts and grounds.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Report any unsatisfactory results to engineer.

END OF SECTION

SECTION 26 24 20 - HVAC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Electrical work relating to the work of Division 23 “MECHANICAL”.

1.2 RELATED DOCUMENTS:

A. The General Conditions, Supplementary Conditions, and applicable portions of Division 1 of the specification are part of this section which shall consist of all labor, equipment, materials and other costs necessary to complete all HVAC ELECTRICAL REQUIREMENTS work indicated on the drawings, herein specified or both.

B. The applicable portions of section 260000 GENERAL are hereby make a part of this section. It is important that you read that section carefully because it expands upon the requirements herein.

1.3 SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Wiring and connection diagrams.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufactures listed.

2.2 HVAC & PLUMBING

A. Provide all wire, conduit, boxes and fittings for all HVAC and plumbing equipment and final connections. Conform to Division 26, Section “Conductors and Cables”.

B. Examine DIVISION 23 carefully for any work specified as performed under this Section and coordinate.

C. Provide all disconnects according to Division 26, Section “Enclosed Switches and Circuit Breakers”.

D. Provide nameplates on all disconnects according to Division 26, Section “Basic Materials and Methods”.

E. Automatic starters and manual starters (thermal toggle switches) to be furnished under DIVISION 26 and installed and wired (both sides) under this Section. Some starters may be variable frequency drive (VFD) type and may have built-in disconnects. Provide wiring on both sides. Some VFD’s are large and heavy. Provide adequate mounting support and proper working space.

F. Provide a manual starter (thermal toggle switch) at each motor not furnished with an automatic starter. Manual starters to consist of a manual operated toggle switch equipped with a melting alloy type thermal overload relay. Starters must be inoperative if thermal unit is removed. Mount at motor location.

G. Temperature controls are provided under DIVISION 23. Temperature control wiring, interlock wiring, and boiler control wiring are provided under DIVISION 23, except as shown on the electrical drawings or indicated differently herein.

H. Provide "Fire-O-Matic" detector, remote shut-off, and associated wiring for each boiler/furnace/water heater.

I. Install and wire to electric heating units furnished under DIVISION 23.

J. Provide power wiring to all control transformers and temperature control panels.

K. Control valves and transformers for all heating units are furnished and installed under DIVISION 23.

L. Do not use electrical drawings for location of feeds to mechanical equipment. In general, use mechanical drawings for bidding purposes and final approved mechanical shop drawings for actual installation. However, report any discrepancies to mechanical and electrical engineer for final determination, prior to installation.

2.3 MAGNETIC STARTERS

A. General Requirements: Provide across-the-line magnetic type starters rated in accordance with NEMA standards, sizes, and horsepower ratings, where indicated on the drawings. Provide enclosures NEMA and UL rated for the environment. Unless otherwise indicated, as a minimum provide NEMA 1 (general purpose) indoors and NEMA 4 (watertight) in damp locations and outdoors.

B. Manufacturers: Provide starters as manufactured by Cutler- Hammer, Square "D", General Electric, or Siemens.

C. Contacts: Provide double break silver alloy contacts. Construct such that contacts are replaceable without removing power wiring or removing starters from the panel. Provide straight-through wiring.

D. Overload Relays and Thermal Units: Provide melting alloy type overload relays with a replaceable control circuit. Construct thermal units of one-piece design and make interchangeable. Make starter inoperative if the thermal unit is removed.

E. Coils: Provide coils of molded construction. Construct such that coils are replaceable from the front without removing the starter from the panel.

F. Auxiliary Contacts: Make starters suitable for the addition of up to three external auxiliary contacts of any arrangement (normally open or normally closed). Provide auxiliary contacts necessary to perform all intended functions.

G. Special Features: Provide the following special features as indicated on the electrical or mechanical drawings or specifications:

HAND-OFF-AUTO	Provide three-position H-O-A switch in cover.
START-STOP	Provide start-stop momentary push buttons in cover.
PILOT LIGHT	Provide pilot light in cover of enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install according to NEMA standards.

B. Mount plumb and rigid without distortion of box.

C. Provide supports and nameplates, according to Division 26 section “Basic Electrical Materials and Methods”.

D. Ground according to Division 26, Section “Grounding, Bonding & Surge Protective Devices”.

E. Provide wiring according to Division 26, Section “Conductors and Cables”.

F. Provide raceways according to Division 26, Section “Raceways and Boxes”.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Snap switches and wall-box dimmers.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Device Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc.
2. Hubbell Incorporated; Wiring Device-Kellems.
3. Leviton Mfg. Company Inc.
4. Pass & Seymour/Legrand; Wiring Devices & Accessories

B. Switch Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc.
2. Hubbell Incorporated; Wiring Device-Kellems
3. Leviton Mfg. Company Inc.
4. Pass & Seymour/Legrand; Wiring Devices & Accessories

2.2 SPECIAL APPLICATION

A. Weather Resistant – All outdoor receptacles shall be listed weather resistant types. Provide with cast aluminum “Weatherproof while-in-use” type cover.

2.3 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498. Heavy Duty Commercial Specification grade.

2.4 GFCI RECEPTACLES

A. General Description: Straight blade type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, 125 V, 20 A and include indicator light that is lighted when device is tripped. Heavy Duty Commercial Specification grade.

2.5 SNAP SWITCHES

A. Heavy Duty Commercial Specification grade.

B. Comply with NEMA WD 1 and UL 20.

C. Switches, 120/277 V, 20 A:

D. 20 A:

1. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

E. Key-Operated Switches, 120/277 V, 20 A:

1. Single pole, with factory-supplied key in lieu of switch handle.

2.6 OCCUPANCY SENSORS

A. Refer to drawings.

B. Wall-Switch Sensors:

1. Refer to drawings

2.7 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Stainless Steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant , die-cast aluminum with lockable cover. Must be in use weatherproof rated.

2.8 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices finished to be as selected by Architect, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. Device must be securely fastened against box / wall. Cover plate to tightly mate with wall without gap.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Electrical Identification".

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under full Load: A value of higher than 5 percent is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

7. Report any testing deficiencies to engineer.

END OF SECTION

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600-V AC and less for use in control circuits, enclosed switches, switchboards, enclosed controllers, and motor-control centers.
2. Plug fuses rated 125-V AC and less for use in plug-fuse-type enclosed switches, fuseholders, and panelboards.
3. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.
4. Spare-fuse cabinets.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

   a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
   b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

B. Operation and Maintenance Data: To include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
4. Coordination charts and tables and related data.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses from a single source from a single manufacturer to the extent possible.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.
5. Gould
6. Equal approved by Engineer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages, at class and current rating indicated.

2.3 PLUG FUSES

A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.4 PLUG-FUSE ADAPTERS

A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

2.5 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 20 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.
5. Cabinet: suitably identified, lockable, compartmented, steel.
6. Provide one spare set (3) of each size and type used.
7. Mount where directed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: Class L, time delay.
2. Feeders: Class L, time delay, Class J, time delay.
3. Motor Branch Circuits: Class RK1, time delay.
4. Other Branch Circuits: Class RK1, time delay.
5. Control Circuits: Class CC, fast acting.

B. Plug Fuses:

1. Motor Branch Circuits: Edison-base type, dual element time delay.
2. Other Branch Circuits: Edison-base type, dual-element time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.

C. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Shunt trip circuit breakers.
4. Molded-case circuit breakers (MCCBs).
5. Molded-case switches.
6. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.[Submit on translucent log-log graph paper.]

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Manufacturer's field service report.

G. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.[Submit on translucent log-log graph paper.]

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended application.

E. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. Square D; a brand of Schneider Electric.
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
4. Siemens Energy & Automation, Inc.

B. Type GD, General Duty: not allowed.

C. Type HD, Heavy Duty, Single Throw, 600-V AC, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.

E. All fusible switches: shall be rated for the application voltage specified and have a UL listed short circuit rating to match the fuse installed.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Siemens Energy & Automation, Inc.
8. Square D; a brand of Schneider Electric.

D. Type HD, Heavy-Duty, Single-Throw Fusible Switch: 600-V ac, at indicated amperage; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

E. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: 600-V ac, at indicated amperage; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

F. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

2.3 SHUNT TRIP SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.

B. General Requirements: Comply with UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120-V ac; obtained from an external control power source as indicated on drawings, of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

E. Accessories:

1. Isolated neutral lug; 100 percent rating.
2. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
3. Form C alarm contacts that change state when switch is tripped.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Where indicated or required, 100% rated, with RMS sensing, field-replaceable rating plug, trip indication (showing which adjustment caused trip), with interrupting capacity to meet available fault current, and with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

F. Arc Flash Reduction Maintenance Technology

1. Breakers where the highest continuous trip setting can be 1200 amps and above shall utilize Arc Flash Reduction Maintenance Technology. The unit shall have a dedicated operation mechanism and visual indication that the reduction technology is operating. The technology shall reduce the trip unit instantaneous pickup value when activated. The device shall not compromise breaker phase protection when enabled. Once the unit is disabled, the recalibration of trip unit phase protection when enabled. Once the unit is disabled, the recalibration of trip unit phase protection shall not be required. Activation and deactivation of the technology trip setting shall be accomplished without opening the circuit breaker door and exposing operators to energized parts.

G. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (5-mA trip).

H. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

I. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

J. Switching Duty: All single pole circuit breakers shall be rated SWD.

K. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits; Type HACR for heating, air-conditioning, and refrigerating equipment..
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
8. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
9. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

2.5 MOLDED-CASE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Anchor floor-mounting switches to concrete base.

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in fusible devices.

F. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

G. Do not mount switches or circuit breakers upside down or side ways.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.
3. Inspect mechanical and electrical connections.
4. Verify switch and relay type and labeling verification.
5. Verify rating of installed fuses.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. The equipment manufacturer shall provide an over-current protective device coordination study. The contractor shall utilize the study to field adjust the circuit breaker trip settings to coordinate the over-current devices throughout the power distribution system.

C. Thermal-magnetic circuit breakers:

1. Test circuit and correct deficiencies
2. Set magnetic trip at minimum.
3. Turn associated loads “on”.
4. Turn breaker on/off a minimum of six (6) times.
5. If nuisance tripping occurs, set “up” one notch and repeat test.
6. Repeat steps 4 and 5 until nuisance tripping no longer occurs.

D. Electronic trip-unit circuit breakers:

1. Test circuit and correct deficiencies.
2. Set “long time pickup” at 1.0 (Do not change)
3. Set other adjustments at minimum.
4. Turn associated loads “on”.
5. Turn breaker on/off a minimum of six (6) times.
6. If nuisance tripping occurs, adjust setting that caused trip “up” one notch and repeat test.
7. Repeat steps 5 and 6 until nuisance tripping no longer occurs.

END OF SECTION

SECTION 26 43 13 - SURGE PROTECTIVE DEVICES (SPDs)

PART 1 - GENERAL

1.1 SCOPE

A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers. Refer to related sections for surge requirements in:

1.2 REFERENCES

A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition).

1.3 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:

1. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL's website or on any other NRTL's website, as long as the website contains the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (I_n).
2. For sidemount mounting applications (SPD mounted external to electrical assembly), electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.

B. Where applicable the following additional information shall be submitted to the engineer:

1. Descriptive bulletins
2. Product sheets

1.4 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Section 1.04 and shall incorporate all changes made during the manufacturing process

1.5 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.6 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

1.7 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall be provided with each SPD shipped.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Eaton

B. Square D

C. Seimens

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.2 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.
3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

5. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.
6. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.
3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
5. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:

   a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.

      i. For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
      ii. For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
      iii. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

   b. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
   c. Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
   d. Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button

shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.

i. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

6. Overcurrent Protection

a. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

7. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.
8. Safety Requirements

a. The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.
c. Sidemount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Sidemount SPDs shall have factory installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

2.3 SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	High Exposure: Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	Medium Exposure Distribution Panelboards	160 kA	80 kA
A	Low Exposure: Branch Locations (Panelboards)	80 kA	40 kA

C. SPD Type – all SPDs installed on the line side of the service entrance disconnect shall be Type 1 SPDs. All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.4 BRANCH AND DISTRIBUTION PANELBOARD REQUIREMENTS

A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
3. The panelboard shall be capable of re-energizing upon removal of the SPD.
4. The SPD shall be interfaced to the panelboard via a direct bus bar connection. Alternately, an SPD connected to a circuit breaker for disconnecting purposes may be installed using short lengths of conductors as long as the conductors originate integrally to the SPD.
   a. SPD shall be connected via 60A-3P circuit breaker and 4#6 + 1#10G. – 1”C, or per manufactures recommendations. The SPD shall be located directly adjacent to the circuit breaker.
5. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
6. The SPD shall be of the same manufacturer as the panelboard.
7. The complete panelboard including the SPD shall be UL67 listed.

B. External Mounting Applications Installation

1. Lead length between the breaker and suppressor shall be kept as short as possible to ensure optimum performance. Any excess conductor length shall be trimmed in order to minimize let-through voltage. SPD shall be connected via 60A-3P circuit breaker and 4#6 + 1#10G. – 1”C, or per manufactures recommendations. The installer shall comply with the manufacturer's recommended installation and wiring practices.

C. Switchgear, Switchboard, MCC and Busway Requirements

1. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
2. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, and busway
3. The SPD shall be factory installed inside the switchgear, switchboard, MCC, and/or bus plug at the assembly point by the original equipment manufacturer

4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
5. The SPD shall be connected through a disconnect (circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
6. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
7. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.5 ENCLOSURES

A. All enclosed equipment shall have NEMA 1 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:

1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).
2. NEMA 4 – Constructed of steel intended for either indoor or outdoor use to provide a degree of protection against access to hazardous parts; to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (dirt and windblown dust); to provide a degree of protection with respect to the harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure. (sidemount units only)
3. NEMA 4X – Constructed of stainless steel providing the same level of protection as the NEMA 4 enclosure with the addition of corrosion protection. (sidemount units only)

PART 3 - EXECUTION

3.1 EXAMINATION

3.2 FACTORY TESTING

A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.3 INSTALLATION

A. The Contractor shall install all equipment per the manufacturer's recommendations and the contract drawings.

3.4 WARRANTY

A. The manufacturer shall provide a full ten (10) year warranty from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local code.

END OF SECTION

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Interior lighting fixtures with LED sources.
2. Lighting fixtures mounted on exterior building surfaces with LED sources.
3. Accessories, plaster rings, fasteners, etc.

1.2 RELATED DOCUMENTS:

A. The General Conditions, Supplementary Conditions, and applicable portions of Division 1 of the specification are part of this section which shall consist of all labor, equipment, materials and other costs necessary to complete all INTERIOR LIGHTING work indicated on the drawings, herein specified or both.

B. The applicable portions of section 260000 - General are hereby make a part of this section. It is important that you read that section carefully because it expands upon the requirements herein.

1.3 SUBMITTALS

A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, and finishes.

B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. FMG Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 LIGHTING LUMINAIRES

A. See schedules on drawings.

B. LED Luminaires shall meet all DesignLights Consortium® (DesignLights.org) Product Qualification Criteria. This does not require that the luminaire be listed on the DesignLights Consortium's® Qualified Products List, but they must meet the Product Qualification Criteria. The technical requirements that the luminaire shall meet for each Application Category as currently defined by the DLC Premium qualification requirements at the time of bid.

C. Color Temperature of 3000K-4100K for interior luminaires as listed in the Luminaire Schedule on the plans. The color temperature of exterior LED luminaires should not exceed 4100K (nominal).

D. Color Consistency: LED manufacturer shall use a maximum 3-step MacAdam Ellipse binning process to achieve consistent luminaire-to-luminaire color for interior luminaires. Exterior luminaires shall use a maximum 3-step MacAdam Ellipse binning process.

E. Luminaire shall be mercury-free, lead-free, and RoHS compliant.

F. Luminaire shall comply with FCC 47 CFR part 15 non-consumer RFI/EMI standards.

G. Light output of the LED system shall be measured using the absolute photometry method following IES LM-79 and IES LM-80 requirements and guidelines.

H. Luminaire shall maintain 70% lumen output (L70) for a minimum of 50,000 hours.

I. Driver shall have a rated life of 50,000 hours, minimum.

J. Lumen output shall not depreciate more than 20% after 10,000 hours of use.

K. Driver and LEDs shall be furnished from a single manufacturer to ensure compatibility.

L. Luminaire Color Rendering Index (CRI) shall be a minimum of 80 for interior luminaires, and a minimum of 70 for exterior luminaires.

M. LED luminaire shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the luminaire is to be installed. Rated case temperature shall be suitable for operation in the ambient temperatures typically found for the intended installation. Exterior luminaires to operate in ambient temperatures of -20°F to 122°F (-29°C to 50°C).

N. LED driver shall have a minimum power factor (pf) of 0.9 and a maximum crest factor (cf) of 1.5 at full input power and across specified voltage range.

O. Luminaire shall operate normally for input voltage fluctuations of plus or minus 10 percent.

P. Luminaire shall have a maximum Total Harmonic Distortion (THD) of 20% at full input power and across specified voltage range.

Q. Wiring connections to LED drivers shall utilize polarized quick-disconnects for field maintenance.

R. All connections to luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.

S. Fuse Protections: All luminaires shall have built-in fuse protection. All power supply outputs shall be either fuse protected or be Polymeric Positive Temperature Coefficient (PTC)-protected as per Class 2 UL listing.

T. The LED luminaire shall carry a limited 5-year warranty minimum for LED light engine(s)/board array, and driver(s).

U. Provide all of the following data on submittals:
   1. Delivered lumens
   2. Input watts
   3. Efficacy
   4. Color rendering index.

V. The failure of one LED shall not affect the operation of the remaining LEDs.

W. Emergency Inverters shall be sine-wave type, or have written confirmation from the luminaire manufacturer that the luminaire will function with a square-wave inverter.

X. LED driver shall be compatible with dimming controls where dimming is indicated on the plans. Dimmable drivers shall use Dimming Constant Current (DCC) or Pulse Width Modulation (PWM) operation.

Y. LED luminaires shall dim to (20%, 15%, 10%, 5%, or 0.1%) as specified in the Luminaire Schedule on the plans without visible flicker or “popcorn effect”. “Popcorn effect” is defined as the luminaire being on a pre-set dimmed level (less than 100%), and going to 100% prior to returning to the pre-set level when power is returned to the luminaire.

2.3 FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Basic Electrical Materials and Methods" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture).

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated, 12 gage2.68 mm.

E. Wires For *Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).*

F. *Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.*

G. *Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.*

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from fixture corners.
2. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.
3. Provide additional support, independent of ceiling grid for all fixtures (including incandescent) by use of jack chain having breaking strength of 3 times the weight of the fixture (minimum of #12). Fixtures over one foot in length shall be supported at all four corners.
4. See section 260548, "Seismic Controls" for additional requirements.

C. Suspended Fixture Support: As follows:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows (stem mounted): Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Continuous Rows (cable mounted): Suspend from cable.
5. Support: Per NEC 410-16.

D. Air-Handling Fixtures: Install with dampers closed and ready for adjustment.

E. Adjust aimable fixtures to provide required light intensities. Adjust all fixtures to the satisfaction of the Engineer. Adjustments required at night shall be done at no additional charge. Provide all equipment needed including scaffolding, if required.

END OF SECTION

SECTION 26 53 00 - NETWORKED LIGHTING CONTROLS

PART 1 - GENERAL

1.1 REFERENCES

A. National Fire Protection Association (NFPA)

B. cULus Listing/Certification

1. Certified as Energy Management Equipment (UL 916)
2. Certified as Emergency Lighting Equipment (UL 924)
3. Meet Heat and Smoke Release for Air-Handling Spaces (UL 2043)

C. CSA Listing/Certification

1. Emergency lighting equipment (CSA C22.2 NO. 141-15)
2. Signal equipment (CSA C22.2 No. 205)

D. Federal Communications Commission (FCC) / Industry Canada (IC)

E. California Energy Commission (CEC)

F. Local Building Codes

1.2 SYSTEM DESCRIPTION

A. Lighting Control System includes computer-based software that provides control, configuration, monitoring and reports. System includes the following components:

1. Wireless Manager
2. System Server
3. 0-10V Dimming, Fixed Output Ballasts or 0-10V LED Drivers
4. Wireless Control Modules
5. Wireless Sensors (Occupancy/Photo)
6. Low-Voltage Sensors (PIR, Dual-Technology, Photo)
7. Wallstations – Wireless/Low-Voltage
8. Lighting Control System Software - Graphical User Interface based
9. LCD Touch Screen Panel
10. Communication Wire
11. Wireless Area Lighting Controllers (to dim/switch a group of luminaires)
12. AC Phase Cut Dimming Module (Forward & Reverse)
13. Relay based Lighting Control Panels
14. Interface to Audio Visual equipment (for integration with 3rd party LCD Touch Screen Panel)
15. Interface to BACnet
16. Interface to Tridium Niagara
17. Interface to customizable Energy dashboard

1.3 SUBMITTALS

A. General: Provide submittals per 1.4 (B – J) below:

B. Bill of Materials: Complete list of all parts needed to fully install selected system components.

C. Product Data: For each type of product indicated.

D. Shop and Wiring Drawings: Submit shop drawings detailing control system, as supplied, including one-line diagrams, wire counts, coverage patterns, interconnection diagrams showing field-installed wiring and physical dimensions of each item.

E. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.

1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.

F. Software Operational Documentation:

1. Software operating and upgrade manuals
2. Program Software Backup: On portable memory storage device, compact disc, or DVD, complete with data files.
3. Printout of software application and graphic screens, or upon request, a live demonstration of Control, Configure and Analyze functionality or a video demonstrating above stated system capabilities.

G. Installation Instructions: Manufacturer's installation instructions.

H. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

I. Warranty: Copy of applicable warranty.

J. Additional information as required on a project specific basis.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installer shall be one who is experienced in performing the work of this section, and who has specialized in installation of work similar to that required for this project.

B. Manufacturer Requirements: The manufacturer shall have a minimum of 15 years' experience manufacturing networked lighting control systems and shall provide 24/7 telephone support by qualified technicians.

C. Contractor shall ensure that lighting system control devices and assemblies are fully compatible and can be integrated into a system that operates as described in the lighting control notes on drawings and as described within this specification. Any incompatibilities between devices, assemblies, and system controllers shall be resolved between the contractor and the system provider, as required to ensure proper system operation and maintainability.

D. Performance Requirements: Shall provide all system components that have been manufactured, assembled, and installed to maintain performance criteria stated by manufacturer without defects, damage, or failure.

E. Performance Testing Requirements

1. Manufacturer shall 100% test all equipment prior to shipment. Sample testing is not acceptable.

F. Code Requirements

1. System Control Unit and System Field Devices shall be cULus listed and certified.
2. All system components shall be FCC /IC compliant.
3. All system components shall be installed in compliance with National Electrical Codes and Canadian Electrical Code.

4. Building Codes: All units shall be installed in compliance with applicable, local building codes.

G. ISO Certification: System components shall be manufactured at ISO-9000 certified plants.

H. Coordination

1. Shall coordinate lighting control components to form an integrated interconnection of compatible components.

a. Match components and interconnections for optimum performance of lighting control functions.
b. Display graphics showing building areas controlled; include the status of lighting controls in each area.

1.5 PROJECT CONDITIONS

A. Operating Temperature Range: -40 deg F (-40 deg C) to 140 deg F (+60 deg C) ‘applicable devices’

B. Humidity

1. Wired field devices: 0% to 100% RH condensing rated for damp locations and 0% to 95% RH non-condensing rated for indoor locations.
2. Wireless modules: 5% to 95% RH non-condensing rated for indoor locations.

1.6 DELIVERY, STORAGE & HANDLING

A. Ordering: Comply with manufacturer’s ordering instructions and lead-time requirements to avoid construction delays.

B. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged packaging with intact identification labels.

C. Storage and Protection: Store materials away from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

1.7 WARRANTY

A. On-going system expansion, service and support shall be available from multiple factory certified vendors. Recommended service agreements shall be submitted at the time of bid complete with manufacturers suggested inventory and pricing for system parts and technical support labor.

B. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship within specified warranty period.

C. Manufacturer’s Warranty: All equipment shall be warranted free of defects in materials and workmanship.

1. Warranty Period: All system hardware components, excluding third party components, shall have full warranty (non-prorated) for a period of forty-eight (48) months and all software, excluding Open Source Software and third party operating systems, perform substantially in accordance with published specifications for a period of twelve (12) months from the date of System Start-up.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Controls: ENCELIUM® Energy Management System by OSRAM SYLVANIA

B. Sensors: ENCELIUM Sensors by OSRAM SYLVANIA, Leviton Mfg. Co., Hubbell Building Automation, Inc., SensorSwitch, Inc., PLC Multipoint Inc., The Watt Stopper, Inc. Cooper Controls or equivalent.

C. 0-10V Dimming, Fixed Output Ballasts and/or 0-10V LED Drivers: OSRAM Sylvania, Inc., Tridonic, Universal Lighting Technologies, Philips Lighting or equivalent.

2.2 SYSTEM PERFORMANCE REQUIREMENTS

This specification is intended to fully describe all of the design, engineering, programming, hardware, software, ancillary devices and associated technical services required to provide a building-wide networked lighting control system. This system is specified to perform scheduled and automated lighting control sequences.

A. The lighting control "system" shall include a fully distributed WAN/LAN network of global controller/routers, individually addressable System Field Devices that are not integral to luminaires, sensors, switches, relays and other ancillary devices required for a complete and operable system. The system WAN/LAN start-up shall be by the control system manufacturer or contractors certified by the manufacturer.

B. The basis of system design shall utilize non-proprietary industry standard 0-10V dimming or fixed output ballasts and/or 0-10V LED drivers, occupancy sensors, daylight sensors, etc.

C. UL 924 listed devices shall have the ability to control 120V/277V/347V load.

D. System software interface shall have the ability to notify communication failures to system users via system & email messages. Email messages shall be available in html and text formats.

E. On-going system expansion, service and support shall be available from multiple factory certified vendors. Recommended service agreements may be submitted at the time of bid complete with manufacturers suggested inventory and pricing for system parts and technical support labor.

F. Lighting Control Software: The system shall offer two separate levels of lighting control: (1) personal lighting control for the average building occupant to control and adjust basic lighting functions in their workspace, and (2) central lighting control for the facility lighting administrator to perform energy management, configuration maintenance, monitoring operations, and providing support to building occupants.

1. Native central control software shall be utilized for energy performance monitoring and complete programming without the need for any third party hardware or software. Systems that require any third party linked software or graphics shall be unacceptable.

2. Software shall provide information on general system settings via mouse click on a floor plan. Left clicking over a device on the graphical software interface shall show a description of the selected device/function attribute.

3. Central Lighting Control:

a. Shall provide an Interactive, Web-based graphical user interface (GUI) showing floor plans and lighting layouts that are native to the lighting control software. The only means required to program and operate the lighting control system shall be programmed and operated from a

user interface that is based on a plan view graphical screen on the user's computer or the lighting control system's main computer. Shall include the navigational features listed below to allow for user's orientation within the controlled space, geographic heading and/or landmarks:

1. Interactive;
2. Vector based;
3. Zoom;
4. Rotate;
5. Pan;
6. Tilt.

b. Shall allow building operator to navigate through an entire facility both in two- dimensional and three-dimensional multi-floor view, allowing for fast and easy navigation.
c. Three-dimensional view shall exclude walls and other structural features to avoid shadowing and cluttering of the plan view.
d. Shall display multiple floors in single view resulting in easier system performance visualization for the entire site as well as individual zones or spaces.
e. Shall allow system performance visualization across a portfolio of buildings via a single interface.
f. All programming, assignments of lighting loads to control strategies, lighting status and lighting energy reporting shall be native to the software and executed from this GUI. Editing shall be available from this GUI in a drag and drop format or from drop down menus without the need for any third party software. Systems that utilize or require third party linked graphics are unacceptable. The GUI shall continuously indicate the status of each connected device on the system and a warning indicator on the software if a device goes offline. Systems requiring spreadsheet editing for programming and that don't offer real time feedback are not acceptable.
g. Software settings and properties shall be selectable per individual device, room based, floor based or global building based.

    1. Lighting Control Software interface shall provide current status and enable configuration of all system zones including selected individual luminaire availability, current light level, maximum light level, on/off status, occupancy status, and emergency mode (response to an emergency signal) status.

h. Shall have the ability to display various lighting system parameters such as Lighting status (ON/OFF); Lighting levels, Load shedding status, or Lighting energy consumption, Occupancy status in a colorized gradient ("weather" map) type of graphical representation.
i. Energy Analysis data shall be exportable in CSV or image file formats.
j. Shall allow import of native AutoCAD files.

    1. Reports: Reporting feature shall be native to the lighting control software and capable of reporting the following parameters for each device and zone individually without requiring any third party hardware and software:

        a. Energy consumption broken down by energy management strategy.
        b. Energy demand broken down by energy management strategy.
        c. Occupancy data by zone.
        d. Building wide occupancy status
        e. Time Schedule status
        f. Lighting energy consumption in a color gradient ("weather map" type) view
        g. Energy performance reports shall be printable in a printer friendly format and downloadable for use in spreadsheet applications, etc.

h. Battery status report indicating device name, location on the floor plan and battery voltage shall be printable in a printer friendly format and downloadable for use in spreadsheet applications, etc.
i. Color gradient ("weather map" type) view for the following:
    1. Robustness of the mesh network (hop count)
    2. Route of the signal
    3. Wireless signal strength
    4. Battery status for wireless components

2. Personal Lighting Control: The Personal Control Software interface shall provide current status and enable each user with the ability to dim and brighten lights, and turn them on and off by individual luminaire or zone. The Software shall offer user configurable light scenes, which may be programmed and then selected via the Software. Personal lighting control shall be available in open/private office environments. This software shall have the capability of acting as a "virtual occupancy sensor" for the system by detecting keyboard or mouse activity on each PC for incremental occupancy status data.
    a. Fade Time: The software shall offer user configurable fade times (up to 86400 seconds) for individual or group of luminaire during transition between scenes.

G. Daylight Harvesting (Light Regulation Averaging): In a photo sensor-equipped system, the Central Controller Unit shall rationalize changes to light levels when ambient (natural) light is available and shall maintain a steady light level when subjected to fluctuating ambient conditions where 0-10V dimming-ballasts and/or drivers exist. Areas equipped with fixed output ballasts and/or drivers shall energize when natural light falls below foot-candle levels specified. System shall utilize light level inputs from common and/or remote sensor locations to minimize the number of photo sensors required. The System shall operate with multiple users in harmony and not react adversely to manual override inputs.

H. Time Clock Scheduling: The system shall be programmable for scheduling lights on or off via the Lighting Control Software interface.
    1. Programming: User friendly, Outlook style interface shall be available for programming schedules.
    2. Override: Manual adjustments via wallstations or personal control software shall temporarily override off status imposed by time clock schedule.
    3. Response to Power Failure: In the event of a power failure, the time clock shall execute schedules that would still be in progress had they begun during the power outage.
    4. Flick Warning: Prior to a scheduled lights-off event or expiry of a temporary override, the system shall provide two short light level drops as a warning to the affected occupants. Flick warning time shall have the ability to be programmed via software between 1 and 5 minutes.
    5. Option to automatically turn on or wait for an input: Using this option, a group of luminaires can be made to turn on automatically in response to a scheduled event or wait for a signal from a wallstation to turn the same group of luminaires on (and stay on) for the reminder of the scheduled event.
    6. Shall support BMS Schedules/Calendars

I. Load Shed Mode: An automatic load shedding mode shall be available where, when activated through the system, the control unit will reduce its output to a programmable maximum electrical demand load. The system shall not shed more load than required and load shedding priority shall be centrally configurable by control zone or by common uses (i.e., all hallways can be treated as one load shed group), with subsequent load shed priority groupings being utilized until the required defined load has been shed, for either a defined period, or until the demand response input has been removed. Systems that simply select a "load shed scene" whereby there is no guarantee that the defined required load will actually be shed are not acceptable.

J. Emergency Mode: There shall be a mode, when activated through the system, that will immediately adjust lights to full light output and retain that level until the mode is deactivated in the event of an emergency. This setting shall override all other inputs. The system shall interface with the building emergency monitoring system at a convenient point and not require multiple connections.

K. Addressing: All ballasts and/or drivers shall be centrally addressable, on a per luminaire or multiple luminaire/zone basis, through the Central Control Software. The basis of design shall utilize 0-10V Dimming, Fixed Output Ballasts and/or 0-10V LED Drivers connected to an Output Module. To simplify ongoing maintenance, the system shall not require manual recording of addresses for the purpose of start-up or reconfiguration.

L. Programmable Task Tuning: The light output level of an individual or group of luminaires shall be programmed via system software.

M. Continuous Dimming: Individual or group of luminaires dimming in response to user initiated action and/or system generated signal shall be over continuous range.

N. Unoccupied State: The system shall provide two states when occupancy status is vacant as per an occupancy sensor - lights turn off or lights adjust to configurable (dimmed) light level.

O. Occupied State: The system shall be capable of creating “comfort” or “support” zones to ensure that occupants are not isolated by turning off lights in adjacent areas, such as a hallway path to exit the premises for occupant comfort and safety.

P. Overlapping Zones: System shall be capable of creating “overlapping” zones to ensure continuous lighting and safety of the occupants as they move from one lighting zone to another (for example, hallways) while minimizing the energy use.

Q. Participation in Intelligent Building Framework: The system shall have the ability to be a component of Intelligent Building framework. Wireless Managers and System server communication shall be based on TCP/IP over Ethernet backbone.

R. LAN Operations: System shall be capable of operating independent of building’s existing network infrastructure if desired and shall not rely on tenant supplied PCs for operation. Network infrastructure shall only be utilized for Personal Control Software.

S. Network Security: Firewall Technologies & VLAN Configuration methods shall be utilized to separate tenants from the lighting control network and ensure the integrity of lighting control network.

T. Lamp Burn In: The system software shall have the capability of not permitting dimming of new lamps prior to completion of lamp manufacturer recommended accumulated operation at full brightness.

U. Lighting Maintenance:

1. System software shall notify wireless low battery, lamp or ballast failure events via system & email messages.
2. Wireless devices hop count, route of the signal, signal strength & battery voltage levels shall be available via GUI.
3. Percentage left in Lamp & Ballast Life Time shall be programmed to display in different colors for easier visual representation and quicker maintenance turnaround time.
4. 0-10V Dimming and/or Fixed Output Ballast/LED Driver replacements shall not require re-programming of the system or re-addressing of the said components.

V. Group (zone) Configuration: The assignment of individual or group of system components to zones shall be performed via Central Control Software such that physical rewiring will not be necessary when workspace reconfiguration or re-zoning is performed. Removal of covers, faceplates, ceiling tiles, etc. shall not be required.

W. Sensor Control Parameters: Occupancy sensor time delays shall be configurable through software. Light level sensor parameters shall be configurable through software.

X. Automatic Time Adjustment: System shall automatically adjust for leap year and daylight savings time and shall provide weekly routine and annual holiday scheduling.

Y. The system software shall have the capability of providing an optional web based energy dashboard to show real time energy savings data and carbon footprint reductions.

Z. Contact closure input: System shall be capable of receiving a momentary and sustained contact closure input from third party sources to control lighting zones.

AA. The system shall have the ability to control (dim/switch) a group of luminaires with loads up to 20A.

BB. Plug Load Control: The system shall offer occupancy sensing or time schedule based plug load control capability.

CC. Astronomical Clock feature: Luminaires switch ON/OFF with the sunset and sunrise (with an option to select offset, depending on the geographic location (latitude & longitude) of the building. An offset option shall be available to turn the schedule ON/OFF up to 12 hours before or after dusk or dawn.

DD. System shall auto-configure lighting controls for spaces that have been combined or divided temporarily by moving wall or similar systems.

EE. System shall automatically lock wallstations and/or disable sensors based on one of the following system inputs: contact closure, a time schedule or the status of a monitored space.

FF. BAS Interface: The light management system shall be capable of interfacing digitally with a building automation system via either BACnet/IP or Tridium Niagara AX interface. The lighting control system shall be capable of communicating the status of output devices (lighting loads) as well as input devices (dry contacts, switches, occupancy sensors, vacancy sensors, and photocells) to the BAS. Building Automation System, utilize data from lighting control system input devices such as occupancy sensors to determine the status (occupied/unoccupied) of the mechanical control zones and perform climate adjustments accordingly.

GG. AV Interface: The light management system shall be capable of interfacing with audio-visual system (e.g. LCD Touch Screen Panel) via TCP/IP interface.

HH. Wireless networks shall be reliable (mesh topology), self-configuring (discovery) and self-healing. Unexpected interruptions in the network shall be automatically compensated for by re-directing communication.

II. Wireless network shall provide high level of security by employing logically unbreakable secure encryption methods (e.g. 128-bit encryption).

JJ. System design shall ensure seamless communication among devices when hybrid wired/wireless control systems are implemented. Hybrid control system refers to devices that communicate over a DALI/Low-Voltage field bus and/or wireless medium that uses non-proprietary open protocol (e.g., ZigBee) for communication. Devices in the hybrid control system shall communicate with all the devices in the system regardless of their native protocol they are designed to work with.

2.3 WIRELESS WALLSTATIONS

A. General: The system shall connect with the wallstations via wireless medium that uses non-proprietary open protocol (e.g., ZigBee) for communication.

1. Software configurable wall station shall provide on/off switching and dimming control for up to six lighting zones/ five lighting scenes per wallstation or more with allowable multi-gang configurations.

2. Shall allow manual dimming of light levels and override of the time schedule.
3. Scenes/zones in the system control software shall be synchronized with the buttons on the wallstation.
4. Addressing: All wallstations shall be individually addressable & reconfigurable via system Control Software.
5. LED's: All wall stations shall feature status LED's
6. Lighting scenes shall automatically reconfigure based on scene changes from personal control software.

B. Electrical:

1. Class 2 Low Voltage device
2. Power source: 2-AA/4-AAA 10-year life Alkaline batteries

C. Communication: Shall be via wireless medium that uses non-proprietary open protocol (e.g., ZigBee) for communication

1. Wireless networks shall be reliable (mesh topology), self-configuring (discovery) and self-healing. Unexpected interruptions in the network shall be automatically compensated for by re-directing communication.
2. Wireless network shall provide high level of security by employing logically unbreakable secure encryption methods (e.g. 128-bit encryption).

D. Performance:

1. Wallstation configuration shall be via GUI in a drag and drop format

   a. Custom button cap configuration shall allow combination of scene & zone in one wallstation
   b. Custom commands shall be applied to individual wallstation buttons
   c. Status LED: Wall station shall display its current status (zone/scene under system control or OFF) when motion is detected in the close proximity of the wallstation

2. The following User Interface and custom labelling options shall be available:

   a. Up to five (5) scene switching & dimming
   b. Up to six (6) zone switching
   c. One (1) zone switching

3. Shall have icons that will illuminate when Loss of communication with the system control unit, Fire Alarm & Wallstation Lock statuses are detected.
4. Shall allow vacancy sensor configuration
5. The battery life statuses of wireless wallstations shall be monitored via GUI.

E. Mechanical:

1. Dimensions: Shall meet NEMA WD-6 spec.
2. Color: Shall meet NEMA WD1 color specifications
3. The following mounting options shall be supported:

   a. Surface mount
   b. Mount in standard size wall box
   c. On mounting brackets for low voltage devices

4. Shall provide support for "Decorator" style wall plate installation

F. Reliability:

1. Operating temperature range: +14 deg F (-10 deg C) to 104 deg F (40 deg C)
2. Humidity: 5% to 95% RH non-condensing rated for indoor locations.

G. Regulatory:

1. Safety: UL916 listed
2. Environmental protection: Rated for dry location; RoHS compliant
3. Radio Interference: FCC Part 15/ICES-003
4. Shall comply or exceed the following electromagnetic requirements:
   a. EN 61000-4-2
   b. EN 61000-4-4
   c. EN 61000-4-5

2.4 LOW VOLTAGE WALLSTATIONS

A. General: The system shall connect with the wallstations via field bus that carry low voltage control signals.

1. Software configurable wall station shall provide on/off switching and dimming control for up to six lighting zones/ five lighting scenes per wallstation or more with allowable multi-gang configurations.
2. Shall allow manual dimming of light levels and override of the time schedule.
3. Scenes/zones in the system control software shall be synchronized with the buttons on the wallstation.
4. Addressing: All wallstations shall be individually addressable & reconfigurable via System Control Software.
5. LED's: All wall stations shall feature status LED's
6. Lighting scenes shall automatically reconfigure based on scene changes from personal control software.

B. Electrical:

1. Class 2 Low Voltage device
2. Power source: Communication bus

C. Communication: Shall be via NEC/CEC Class 2 communication wire

D. Performance:

1. Wallstation configuration shall be via GUI in a drag and drop format
   a. Custom button cap configuration shall allow combination of scene & zone in one wallstation
   b. Custom commands shall be applied to individual wallstation buttons
   c. Status LED: Wall station shall display its current status (zone/scene under system control or OFF) when motion is detected in the close proximity of the wallstation
2. The following User Interface and custom labelling options shall be available:
   a. Up to five (5) scene switching & dimming
   b. Up to six (6) zone switching
   c. One (1) zone switching
3. Shall have icons that will illuminate when Loss of communication with the system control unit, Fire Alarm & Wallstation Lock statuses are detected.
4. Shall allow vacancy sensor configuration

E. Mechanical:

1. Dimensions: Shall meet NEMA WD-6 spec.
2. Color: Shall meet NEMA WD1 color specifications
3. The following mounting options shall be supported:
   a. Mount in standard size wall box
   b. On mounting brackets for low voltage devices
4. Shall be used with "Decorator" style wall plate

F. Reliability:

1. Operating temperature range: 14 deg F (-10 deg C) to 140 deg F (60 deg C)
2. Humidity: 5% to 95% RH non-condensing rated for indoor locations.

G. Regulatory:

1. Safety: UL916 listed
2. Environmental protection: Rated for dry location; RoHS compliant
3. Radio Interference: FCC Part 15/ICES-003
4. Shall comply or exceed the following electromagnetic requirements:

   a. EN 61000-4-2
   b. EN 61000-4-4
   c. EN 61000-4-5

2.5 TOUCH SCREEN PANEL

A. General: Shall enable the ability to display light level, status and recall multiple lighting scenes.

B. Electrical:

1. Input voltage: Shall be via Power over Ethernet or +9VDC to +16VDC, 1A max.

C. Communication: Shall be via Ethernet connection that employs TCP/IP protocol

D. Performance:

1. Full color 7" TFT LCD, Full VGA (800 x 480 pixels) with 65K colors
2. CPU: 32 bit, 533 MHz
3. Memory: 128 Non-volatile Flash Memory
4. Flexible configurations for custom buttons, text and graphics
5. Integrated high-resolution capacitive touch screen

E. Mechanical: Shall be wall mountable

F. Reliability:

1. Operating Temperature Range: -32 deg F (0 deg C) to +122 deg F (+50 deg C)
2. Humidity: 0% to 95% RH non-condensing rated for indoor locations

2.6 WIRELESS CONTROL MODULES (WCM)

A. General: Wireless Modules shall enable wireless connectivity to 0-10V Dimming, Fixed Output Ballasts and/or 0-10V LED Drivers. Addresses to the wireless modules shall be assigned during system start-up. Upon establishing two way communication with the Wireless Controller, these individually addressable modules shall enable each lighting component to be independently controlled and configured to best meet the needs of the facility.

1. Addressing: Wireless Modules shall be individually addressable via System Control Software.
2. System shall automatically address individual wireless modules during system start-up thus eliminating the need to pre-address devices or record serial numbers during installation.

B. Electrical: Ratings for Ballast/General purpose/Tungsten shall be: 120V – 347VAC (+/-10%)

C. Communication: Shall be via wireless medium that uses non-proprietary open protocol (e.g., ZigBee) for communication

1. Wireless networks shall be reliable (mesh topology), self-configuring (discovery) and self-healing. Unexpected interruptions in the network shall be automatically compensated for by re-directing communication.
2. Wireless network shall provide high level of security by employing logically unbreakable secure encryption methods (e.g. 128-bit encryption).

3. Shall connect to NEC/CEC Class 2 communication wire

D. Performance:

1. Control Options

a. ON/OFF Switching
b. Continuous dimming

2. Air Gap Off: Shall enforce physical disconnection of AC power to the ballast or driver when "OFF" is selected either automatically or manually.
3. Shall be able communicate with 0-10V ballasts/drivers as well as DALI ballasts/drivers
4. Shall enable wireless connection to low-voltage infrared, ultrasonic, and multi-technology sensors, Relay based Lighting Control Panels, and AC Phase Cut Dimming Modules.
5. Shall be used to extend wireless network capability
6. Memory: Shall retain all system settings in non-volatile memory

E. Mechanical:

1. Dual mounting: Mounts inside a standard (4" x 4") j-Box or to ½" knock-out
2. Material: Plenum rated black plastic (UL2043)

F. Reliability:

1. Operating temperature range: -40 deg F (-40 deg C) to 140 deg F (60 deg C)
2. Humidity: 5% to 95% RH non-condensing rated for indoor locations.

G. Regulatory:

1. Safety: UL916, UL924 & UL2043 listed
2. Environmental protection: Rated for damp location (IP54); RoHS compliant
3. Radio Interference: FCC Part 15/ICES-003
4. Complies with the following electromagnetic requirements:

a. EN 61000-4-2
b. EN 61000-4-4
c. EN 61000-4-5

2.7 WIRELESS AREA LIGHTING CONTROLLER (WALC)

A. General: Shall provide a common interface (DIM/SWITCH) to a group of 0-10V Dimming, Fixed Output Ballasts and/or 0-10V LED Drivers over wireless medium that uses non-proprietary open protocol (e.g., ZigBee) for communication.

1. Addressing: Area Lighting Controllers shall be addressable via Control Software.
2. System shall automatically address individual wireless area lighting controllers during system start-up thus eliminating the need to pre-address devices or record serial numbers during installation.

B. Electrical:

1. Maximum Load Ratings:

a. 20A 120-347 Vac Ballast
b. 20A 120-347 Vac Resistive
c. 20A 120-347 Vac Tungsten
d. 20A 120-347 Vac General Purpose
e. 1.5 HP 120-277 Vac Motor

C. Communication: Shall be via wireless medium that uses non-proprietary open protocol (e.g., ZigBee) for communication

1. Wireless networks shall be reliable (mesh topology), self-configuring (discovery) and self-healing. Unexpected interruptions in the network shall be automatically compensated for by re-directing communication.
2. Wireless network shall provide high level of security by employing logically unbreakable secure encryption methods (e.g. 128-bit encryption).
3. Shall connect to NEC/CEC Class 2 communication wire

D. Communication: Shall be via wireless medium that uses non-proprietary open protocol (e.g., ZigBee)

E. Performance:

1. Control Options

   a. ON/OFF Switching
   b. Continuous dimming
   c. Shall be able to communicate with 0-10V ballasts/drivers

2. Shall be used for general purpose plug load control
3. Group Control: Shall control up to 50 ballast/LED Drivers
4. Shall enable direct 0-10V sensor connection
5. Shall enable wireless connection to low-voltage infrared, ultrasonic, and multi-technology sensors, Relay based Lighting Control Panels and AC Phase Cut Dimming Modules.
6. Air Gap Off: Shall enforce physical disconnection of AC power to the ballast or driver when “OFF” is selected either automatically or manually.
7. Memory: Shall retain all system settings in non-volatile memory

F. Mechanical:

1. Mounting: Standard 1/2" electrical box knockout
2. Material: Plenum rated black plastic (UL2043)

G. Reliability:

1. Operating temperature range (wireless): -40 deg F (-40 deg C) to 149 deg F (65 deg C)
2. Humidity: 5% to 95% RH non-condensing rated for indoor locations

H. Regulatory:

1. Safety: UL916, UL924 & UL2043 listed
2. Environmental protection: Rated for damp location; RoHS compliant
3. Radio Interference: FCC Part 15/ICES-003
4. Shall comply or exceed the following electromagnetic requirements:

   a. EN 61000-4-2
   b. EN 61000-4-4
   c. EN 61000-4-5

2.8 COMMUNICATION WIRE (GREENBUS)

A. General: The system shall have the capability to use both NEC/CEC Class 1 and Class 2 wiring to integrate peripheral devices such as ballasts/LED drivers, occupancy sensors, photo sensors, relay-based controls, area lighting controllers, wireless sensors and wallstations into a complete, networked programmable lighting control system.

B. Electrical: NEC/CEC Class 2 Communication bus

C. Mechanical:

1. Multi-conductor cable with stranded-copper conductors

D. Performance:

1. Shall power photo sensors, PIR and dual-technology occupancy sensors.
2. Shall allow random devices connection without the need for special network channel termination.
3. Minimize system down time by self-diagnosing the field bus for any shorts and open loops.

E. Regulatory:

1. Flame rated jacket for plenum use NFPA 262 (UL: FT6, CSA: CMP).

2.9 RELAY BASED LIGHTING CONTROL PANELS (RP/RPM)

A. General: An addressable lighting control panel that allows each relay to be individually controlled and configured.

1. Addressing: All lighting control panel relays shall be individually addressable via Central Control Software.
2. Relay Panel Modules are suitable for 35 mm DIN rail mounting.

B. Electrical:

1. Input Power Supply: 40 VA, 50/60 Hz

C. Communication:

1. Shall be via NEC/CEC Class 2 communication wire
2. Wireless communication shall be enabled via Wireless Control Module/Wireless Area Lighting Controller

D. Performance: ON/OFF Switching at Circuit level

E. Reliability:

1. Maximum Operating Ambient Temperature: 140 deg F (60 deg C).

F. Regulatory:

1. Safety: UL916, UL924 listed
2. Radio Interference: FCC Part 15/ICES-003
3. Shall comply or exceed the following electromagnetic requirements:
   a. EN 61000-4-2
   b. EN 61000-4-4
   c. EN 61000-4-5

2.10 LOW VOLTAGE PHOTO SENSOR

A. General: Photo sensor connectivity shall be via field bus that carry low voltage control signals.

B. Electrical:

1. Class 2 Low Voltage device
2. Power source: Communication bus

C. Communication:

1. Shall be via Class 2 communication bus
2. Wireless communication shall be enabled via Wireless Control Module/Wireless Area Lighting Controller

D. Performance:

1. Accuracy: +/-1% at 21 deg C (70 deg F), derated to +/-5% at 49 deg C (120 deg F) or at -18 deg C (0 deg F).
2. The indoor sensor range shall be between 0 and 750 FC.
3. The Outdoor sensor range shall be between 0 and 750 FC.
4. Atrium sensor range shall be from 2 to 2,500 FC.

5. Skylight sensor range shall be between 10 and 7,500 FC.

E. Mechanical:

1. Mounting options shall include the following:

a. Junction Box mounting
b. Knock-out mounting

F. Reliability:

1. Operating temperature range: 13 deg F ((-11 deg C) to +140 deg F (60 deg C)
2. Humidity: 5% to 95% RH (non-condensing)

2.11 LOW VOLTAGE OCCUPANCY SENSORS (PIR, ULTRASONIC OR DUAL-TECHNOLOGY)

A. General: Occupancy sensor connectivity shall be via field bus that carry low voltage control signals.

1. Shall allow timeouts configurable via system software.
2. Sensors using passive infrared, ultrasonic, microphonic, and multi-technology shall be available.
3. Shall allow occupancy and vacancy sensor configurations via system software.
4. Depending on the software configuration shall switch or dim the luminaires.
5. Shall allow overlapping and comfort zone configurations via system software.

B. Electrical:

1. Class 2 Low Voltage device
2. Power source: Communication bus

C. Communication:

1. Shall be via Class 2 communication bus
2. Wireless communication shall be enabled via Wireless Control Module/Wireless Area Lighting Controller

D. Performance:

1. Shall allow flexible timer settings
2. Shall have the ability to self-calibrate and retain settings during power interruptions
3. Shall have the ability to automatically analyze and adjust sensitivity and time delay
4. Shall provide the following coverage:

a. Ceiling mount: 450 sq. ft. to 2000 sq. ft.
b. Wall mount: 1200 sq. ft. to 2500 sq. ft.

E. Mechanical:

1. Wired: Sensors for mounting on ceilings and walls, including corners, shall be available.

F. Reliability:

1. Operating temperature range: 32 deg F to +104 deg F. (0 deg C to 40 deg C)
2. Humidity: 0% to 95% RH (non-condensing)

2.12 WIRELESS SENSORS

A. Sensors shall have built-in occupancy & daylight sensing capability. Shall connect to the Lighting Control System via wireless medium that uses non-proprietary open protocol (e.g., ZigBee) for communication.

B. Electrical:

1. Class 2 Low Voltage device

a. Power source: Two (2) AA Alkaline batteries or equivalent with 10-year battery life

C. Communication: Shall be via wireless medium that uses non-proprietary open protocol (e.g., ZigBee) for communication

1. Wireless networks shall be reliable (mesh topology), self-configuring (discovery) and self-healing. Unexpected interruptions in the network shall be automatically compensated for by re-directing communication.

2. Wireless network shall provide high level of security by employing logically unbreakable secure encryption methods (e.g. 128-bit encryption).

D. Performance:

1. Shall perform both occupancy and daylight harvesting
2. The battery life shall be monitored via system software.
3. Indicator light: Indicator light to signify different sensor statuses (failure, start-up, etc.)
4. Tool less mounting options shall be available:

   a. Invisible mark mounting
   b. Magnetic mounting

5. Sensor timeouts shall be configurable via system software.
6. Occupancy/Vacancy sensor configurations shall be performed via system software.
7. Depending on the software configuration shall switch or dim the luminaires.

8. Shall allow overlapping and comfort zone configurations via system software.
9. Shall supply a wireless signal to the Lighting Management System proportional to the light measured.
10. Shall provide the daylight sensor range shall be between 0 and 100 FC (0 to 1000 Lux)
11. Shall provide the following occupancy coverage:

    a. 450 sq. ft. with micro-motion sensitivity
    b. 1500 sq. ft. long range with high sensitivity core

E. Mechanical:

1. Dimensions: 3.37” diameter (85.49mm) x 1.13” (28.6mm) height (standard range) / 0.98” (25mm) height (long range)
2. Mounting

   a. The following tool less mounting options shall be available:

      1. Invisible mark mounting
      2. Magnetic mounting

   b. Other mounting options shall include the following:

      1. Junction Box mounting
      2. Knock-out mounting

3. Plastic material

F. Reliability:

1. Operating temperature range: 32 deg F to 104 deg F (0 deg C to 40 deg C)
2. Humidity: 5% to 95% RH (non-condensing)

G. Regulatory:

1. Environmental protection: Rated for dry location; RoHS compliant

2.13 WIRELESS MANAGER (WM)

A. General: The wireless manager shall be the central intelligence point for the area that it controls, collecting signal information from sensors, wallstations and personal control software and

determining appropriate brightness levels or on/off status for each luminaire or zone. Each wireless manager shall control large quantity of wireless devices. The wireless manager shall automatically detect and during start-up addresses the compatible sensors, wallstations & system field devices it is connected to and establishes two-way communication.

The wireless manager shall communicate with the server over Ethernet connection that employs TCP/IP protocol. The wireless manager shall connect with a facility's or tenant's Local Area Network (LAN) via Ethernet connection to enable desktop personal control.

B. Electrical:

1. Input voltage: Via Power over Ethernet

C. Communication: Shall be via wireless medium that uses non-proprietary open protocol (e.g., ZigBee) for communication

1. Wireless networks shall be reliable (mesh topology), self-configuring (discovery) and self-healing. Unexpected interruptions in the network shall be automatically compensated for by re-directing communication.
2. Wireless network shall provide high level of security by employing logically unbreakable secure encryption methods (e.g. 128-bit encryption).
3. Server communication shall be via TCP/IP over Ethernet

D. Mechanical:

1. Plastic material
2. Mounting: Ceiling or wall mount via j-box

E. Visualization & Performance:

1. Manages large number of nodes
2. Shall appear in system software
3. Shall be configured via system software
4. Shall display transmit/receive signal strength with the nodes on the floor plan
5. Shall display hop count information with the nodes on the floor plan

F. Reliability:

1. Ambient temperature range: 32 deg F (0 deg C) to 104 deg F (40 deg C)
2. Humidity: 5% to 95% RH non-condensing rated for indoor locations.

G. Regulatory:

1. Safety: UL916 listed
2. Environmental protection: Rated for dry location; RoHS compliant
3. Radio Interference: FCC Part 15/ICES-003
4. Complies with the following electromagnetic requirements:
   a. EN 61000-4-2
   b. EN 61000-4-4
   c. EN 61000-4-5

2.14 SYSTEM SERVER (SSU)

A. General: System Server shall host the lighting control system database for all the lighting control devices. In addition, it shall provide remote accessing capability to change system settings and/or parameters.

Server shall have the ability to:

1. Analyze system performance or energy data or generate system report;
2. Record energy consumption with average sampling every 5 minutes for unlimited duration;
3. Host the web interface required for the web enabled Personal Control Software or web based Central Control Software;
4. Reside on a client server (virtual server) thus eliminating the need for dedicated physical hardware if desired;
5. Interconnect with Wireless Managers over standard Ethernet connection that employs TCP/IP protocol;

Hardware based servers shall at minimum meet the specifications listed below:

B. Electrical:

1. Power Supply: 120V/60Hz/200W. Provide dedicated 120V receptacle fed from a dedicated normal power circuit.

C. Communication:

1. Each System Server shall have two Ethernet 10/100Base - Tx Cat 5 RJ45 ports that employ TCP/IP protocol.

D. Mechanical:

1. Shall mount in a standard 19” rack (1U width), or alternatively where no rack is shown, via an individual wall mount.

E. Reliability:

1. Operating temperature range: 50 deg F (10 deg C) to 95 deg F (35 deg C)
2. Operating Relative Humidity: 10% to 90% (non-condensing)

F. Regulatory:

1. FCC (US only) Class A.
2. DOC (Canada) Class A.
3. UL 60950.
4. CAN/CSA-C22.2 No. 60950.

2.15 LIGHTING CONTROL SYSTEM SOFTWARE

A. Personal Control Software: Shall enable individuals in a building to control lighting levels in their workspace from their own desktop PC. Shall enable light level control for each luminaire in their workspace or control all of the luminaire together as a group. Preset lighting scenes shall be stored, recalled and modified. This software shall have the capability of acting as a “virtual occupancy sensor” for the system by detecting keyboard or mouse activity on each PC for incremental occupancy status data.

1. Technical Information:

a. TCP/IP network traffic < 2kb/s.

B. Web based Personal Control Software: Shall enable majority of the Personal Control Software features via a web browser. Shall allow tasks such as individual luminaire dimming control, on/off switching, modify and save preset lighting scenes.

C. Technical Information: Adobe Flash ® based user interface.

1. System shall require:

a. Internet web browser with Flash® Player 8 or later.
b. Internet/Intranet connection.

c. SSU enabled and configured to host dynamic website.
d. Network connection with access to a network-enabled WM.

D. Web based Central Control Software: Central control software application shall be used to start-up, configure and manage the system. Every system parameter in a building (or campus of buildings) shall be configured for each individual user or space and baseline settings shall be established for each of the following (depending on the basis of design) system features:

1. Daylight harvesting.
2. Occupancy control.
3. Smart time scheduling.
4. Task tuning.
5. Personal control.
6. Load shedding.

Software shall utilize a web based interface that permits a user to easily navigate between zones, floors or different buildings and allows a user to zoom in or zoom out of specific areas of a building. Both 3-dimensional and two-dimensional multi-floor views shall be available. System features such as creation of zone hierarchies, overlapping and support zone definitions, user access rights, timeout settings for occupancy sensors, calibration of light levels for daylight harvesting and the configuration of multiple time schedule profiles shall be available. A web based Graphical User Interface (GUI) application integral to the system shall be used to develop a dynamic, real-time, point-and-click graphic of each floor plan with representation of all light luminaire, wallstations, sensors, switches, etc. A central system server shall be provided to support system data base and enterprise control management.

1. System shall require:

a. Software that can run on a Windows Operating systems (Windows XP or newer) and also on Apple Mac Intel PCs (Mac OS 10.4 or newer).
b. Ability to support all common browsers, i.e.,

- Internet Explorer 6.0 or later
- Mozilla Firefox 3.0 or later
- Safari
- Google Chrome

c. Network connection/access to all network-enabled CUs.
d. Native Energy Performance Monitoring capability
e. Color gradient ("weather map" type) data view (see below for an example) to display the following criteria:

- Lamp & ballast life time
- Current energy consumption
- Current energy savings
- Current luminaire brightness
- Current luminaire status
- Current occupancy data
- Current load shedding status
- Hop count
- Route of the signal
- Signal Strength
- Battery Voltage Status
- Other custom modes that may be specified elsewhere

2.16 AUDIO-VISUAL INTERFACE

A. General: Shall allow users command (e.g. LCD Touch Screen Panel) various lighting scenarios depending on the audio & visual requirements of the room or building.

1. The lighting control system shall interface to the AV system via TCP/IP protocol using Telnet.
2. The lighting control system shall allow a common AV processor to individually control multiple rooms from a single TCP/IP port through unique room, zone, and scene addresses for lighting in each room.

2.17 BAS INTERFACE

A. General: Two separate software interfaces (BACnet/IP or Tridium Niagara AX) shall be available for integration with Building Automation System. The lighting control system, via these interfaces, communicate the status of output devices (lighting loads) as well as input devices (dry contacts, switches, occupancy sensors, vacancy sensors, and photocells) over to the building automation system. Building Automation System, utilize data from lighting control system to switch/dim lighting, perform load shedding of lighting load, to turn lights on in response to emergency signal through fire alarm and perform HVAC adjustments.

1. The Lighting Control System shall support the following BACnet Objects:

a. Binary Value:

1. Light Zone State: State of the defined lighting zone – ON or OFF

b. Analog Value:

1. Light Zone Dimming: Light output level of the defined lighting zone, from 100% (maximum light output) to 0% (minimum light output)

c. Scheduling:

1. Support for BACnet Schedules/Calendars

d. Analog Input:

1. Shed Request: Requested total amount of load reduction, defined in watts or as a percentage of sheddable load
2. Shed Request (Group): (As above, for the selected group)

e. Analog Output:

1. Photo Sensor Daylight Readings (available via BACnet interface only): Reports daylight readings by photo sensors
2. Sheddable Load: Reports the total lighting load available for load reduction according to the Light Management System, defined in watts
3. Sheddable Load (Group): (As above, for the selected group)
4. Shed Status: Reports the total current load reduction achieved according to Light Management System defined prioritization, defined in watts
5. Shed Status (Group): (As above, for the selected group)
6. Load Shedding Total Demand: Reports the total lighting demand of all devices in a load shedding group (in Watts)

f. Binary Input:

1. Fire Alarm State: State of the fire alarm system – alarm activated or alarm not activated

g. Binary Output:

1. Occupancy State: State of the defined occupancy sensor – occupancy detected or not detected

2. The Lighting Control System shall allow Floor plans imports into Tridium Niagara AX:

   a. Importing lighting control software floor plans into Tridium Niagara AX framework for viewing current status and changing the proxy values.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification: Verify that wiring conditions, which have been previously installed under other sections or at a previous time, are acceptable for product installation in accordance with manufacturer's instructions.

B. Inspection: Inspect all material included in this contract prior to installation. Manufacturer shall be notified of unacceptable material prior to installation.

3.2 INSTALLATION

A. The Electrical Contractor, as part of the work of this section, shall coordinate, receive, mount, connect, and place into operation all equipment. The Electrical Contractor shall furnish all conduit, wire, connectors, hardware, and other incidental items necessary for properly functioning lighting control as described herein and shown on the plans (including but not limited to System Field Devices, 0-10V dimming ballasts, fixed output ballasts, 0-10V LED drivers and communication wire). The Electrical Contractor shall maintain performance criteria stated by manufacturer without defects, damage, or failure.

B. Power: The contractor shall test that all branch load circuits are operational before connecting loads to sensor system load terminals, and then de-energize all circuits before installation.

C. Related Product Installation: Refer to other sections listed in Related Sections for related products' installation.

3.3 SENSOR INSTALLATION

A. Adjust sensitivity to cover area installed

B. Set time delay on occupancy sensors that are connect to the lighting control system to the minimum. Time delays shall be controlled via Central Control Software.

C. Vacancy sensor configurations shall be via Central Control Software.

D. Sensors shall be powered through Input Module, Wireless Control Module, Kinetic energy or batteries.

E. Install occupancy sensors on vibration free stable surface.

F. Install atrium and skylight light sensor facing toward window or skylight.

G. Install interior light sensor in ceiling facing the floor.

3.4 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.

B. Wiring within Enclosures: Comply with NEC & CEC. Separate power-limited and non power-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 SOFTWARE INSTALLATION

A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current site licenses for software.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following field tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing wallstations and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Lighting control devices will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.7 SYSTEM START-UP REQUIREMENTS & SUPPORT SERVICES

A. System Start-up: The manufacturer shall supply factory trained representatives to start-up the lighting control system.

B. Training: As part of the system start-up service, the provider of the service shall train the facility staff, or end users, responsible for changing the lighting characteristics in a building in the operation of the system. The start-up service provider shall also provide owner's representatives with system operating manuals.

C. Extended Service Coverage: Maintenance agreements shall be available from the manufacturer to provide service for the system both during and after the warranty period.

D. Requests for start-up or technical services shall be at least fifteen (15) business days prior to date desired for service.

E. Electrical contractor shall perform functional testing under the guidance of technical service agent and in accordance with factory specified guidelines.

F. Technical service provider shall provide technical services for the lighting control system.

1. Verify proper communication over control wires.
2. Map addresses of all devices.
3. Verify communication to wireless managers and system server.
4. Software configuration of occupancy sensors, light level sensors, wallstations and other contacts to suit design specifications.
5. Configure and program lighting control sequences as described on contract documents.
6. Demonstrate to Owner and Engineer proper operation of all areas the system is installed.

3.8 TESTING

A. Upon completion of all line, load and interconnection wiring, and after all luminaire are installed and lamped, a qualified factory representative shall completely configure and test the system.

B. At the time of checkout and testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.

3.9 DEMONSTRATION

A. The provider of the service shall train the facility staff, or end users, responsible for changing the lighting characteristics in a building to adjust, operate, utilize, troubleshoot, conduct software installation, and maintain lighting controls and software training for PC-based control systems.

B. Demonstrate to National Grid the system functionality, control strategies, and minimum energy savings of 40% relative code baseline to ensure compliance with the Networked Lighting Controls incentive being sought by this project's Owner.

END OF SECTION

SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Community College of Rhode Island Information Technology Standards.

1.2 SUMMARY

A. Section Includes:

1. Grounding conductors.
2. Grounding connectors.
3. Grounding busbars.
4. Grounding rods.
5. Grounding labeling.

1.3 DEFINITIONS

A. BCT: Bonding conductor for telecommunications.

B. TGB: Telecommunications grounding busbar.

C. TMGB: Telecommunications main grounding busbar.

D. Service Provider: The operator of a service that provides telecommunications transmission delivered over access provider facilities.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:

1. Ground rods.
2. Ground and roof rings.
3. BCT, TMGB, TGBs, and routing of their bonding conductors.

B. Qualification Data: For Installer, installation supervisor, and field inspector.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Result of the ground-resistance test, measured at the point of BCT connection.
b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Installation Supervision: Installation shall be under the direct supervision of ITS Technician, who shall be present at all times when Work of this Section is performed at Project site.
2. Field Inspector: Currently registered by BICSI as a designer RCDD to perform the on-site inspection.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

C. Comply with TIA-607-B.

2.2 CONDUCTORS

A. Comply with UL 486A-486B.

B. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.

1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
2. Cable Tray Equipment Grounding Wire: No. 6 AWG.

C. Cable Tray Grounding Jumper:

1. Not smaller than No. 6 AWG and not longer than 12 inches (300 mm). If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
2. Not smaller than No. 10 AWG and not longer than 12 inches (300 mm). If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.

D. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmils (14.2 sq. mm), 14 strands of No. 17 AWG conductor, and 1/4 inch (6.3 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.3 CONNECTORS

A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

B. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.

1. Electroplated tinned copper, C and H shaped.

C. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.

D. Busbar Connectors: Cast silicon bronze, solderless compression-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch (15.8- or 25.4-mm) centers for a two-bolt connection to the busbar.

E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

A. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 4” W x 1/4” W x 12” L. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide a 4-inch (100-mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

B. TGB: Predrilled rectangular bars of hard-drawn solid copper, 2” W x 1/4” H x 12” L inches. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-B.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch (50-mm) clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

C. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-607-B. Predrilling shall be with holes for use with lugs specified in this Section.

1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch (483- or 584-mm) equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
3. Rack-Mounted Vertical Busbar: 72 or 36 inches (1827 or 914 mm) long, with stainless-steel or copper-plated hardware for attachment to the rack.

2.5 IDENTIFICATION

A. Comply with requirements for identification products in Section 270553 "Identification for Communications Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.

B. Inspect the test results of the ac grounding system measured at the point of BCT connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.

B. Comply with NECA 1.

C. Comply with TIA-607-B.

3.3 APPLICATION

A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Connections to Ground Rods at Test Wells: Bolted connectors.
3. Connections to Structural Steel: Welded connectors.

C. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches (900 mm).

D. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36-inch (900-mm) intervals.
4. Install grounding and bonding conductors in 3/4-inch (21-mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.

   a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 1/0 AWG.

3.5 GROUNDING BUSBARS

A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 12 inches (300 mm) above finished floor unless otherwise indicated.

B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.

B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:

1. Use crimping tool and the die specific to the connector.
2. Pretwist the conductor.
3. Apply an antioxidant compound to all bolted and compression connections.

D. Primary Protector: Bond to the TMGB with insulated bonding conductor.

E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot (1 sq. mm/linear meter) of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.

F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.

G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.

H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.

I. Rack and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

3.7 IDENTIFICATION

A. Labels shall be preprinted or computer-printed type.

1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.

   a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.

3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.

a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.

D. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION

SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Community College of Rhode Island Information Technology Standards.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Metal wireways and auxiliary gutters.
5. Nonmetallic wireways and auxiliary gutters.
6. Metallic surface pathways.
7. Nonmetallic surface pathways.
8. Hooks.
9. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid conduit.

C. IMC: Intermediate metal conduit.

D. RTRC: Reinforced thermosetting resin conduit.

1.4 ACTION SUBMITTALS

A. Product data for the following:

1. Surface pathways
2. Wireways and fittings.
3. Boxes, enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

C. Samples: For wireways and surface pathways and for each color and texture specified, 12 inches (300 mm) long.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of pathway groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
3. Existing equipment that is to remain.

B. Qualification Data: For professional engineer.

C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.

B. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
2. Comply with TIA-569-D.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated GRC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel.
b. Type: Set screw or compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for plenum installation unless otherwise indicated.

B. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

C. Comply with TIA-569-D.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal trough of rectangular cross section fabricated to required size and shape, without holes or knockouts, and with hinged or removable covers.

B. General Requirements for Metal Wireways and Auxiliary Gutters:

1. Comply with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
3. Comply with TIA-569-D.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE METAL PATHWAYS

A. Manufacture:
1. Panduit (Per CCRI Standards)

B. Description: Galvanized steel with snap-on covers, complying with UL 5.

C. Finish: Manufacturer's custom enamel finish in color selected by Architect.

D. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

E. Comply with TIA-569-D.

2.5 HOOKS

A. Description: Prefabricated sheet metal cable supports for telecommunications cable.

B. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

C. Comply with TIA-569-D.

D. Galvanized steel.

E. J shape.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Description: Enclosures for communications.

B. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-D.
2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
4. Device Box Dimensions: 5 inches square by 2-7/8 inches deep.
5. Gangable boxes are prohibited.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Metal Floor Boxes:

1. As indicated on drawings.
2. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Floor boxes feed from the floor below shall be considered poke-thru and have a matching fire rating of the floor assemble.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, [cast aluminum] [galvanized, cast iron] with gasketed cover.

G. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

H. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

I. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:

   a. Back of house spaces.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Mechanical rooms.
   d. Storage Areas.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Damp or Wet Locations: GRC.
6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT.
8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in institutional and commercial kitchens and damp or wet locations.

B. Minimum Pathway Size: 1” (25-mm) trade size for category cables, and 1 inch (25 mm) for optical-fiber cables.

C. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use set-screw, steel fittings. Comply with NEMA FB 2.10.

D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

E. Install surface pathways only where indicated on Drawings.

3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101
5. NECA 102.
6. NECA 105.

7. NECA 111.

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

C. Comply with requirements in Division 7 "Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

D. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

E. Complete pathway installation before starting conductor installation.

F. Arrange stub-ups so curved portions of bends are not visible above finished slab.

G. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.

H. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

I. Support conduit within 12 inches (300 mm) of enclosures to which attached.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.

O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits of 2-inch (50-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

R. Surface Pathways:

1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
2. Install surface pathway with a minimum 2-inch (50-mm) radius control at bend points.
3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

S. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch (21-mm) Trade Size and Smaller: Install pathways in maximum lengths of 50 feet (15 m).
2. 1-Inch (25-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).
3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

T. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.

U. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC[and EMT] that is located where environmental temperature change may exceed 100 deg F (55 deg C), and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
3. Hook spacing shall allow no more than 6 inches (150 mm) of slack. The lowest point of the cables shall be no less than 6 inches (150 mm) adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
4. Space hooks no more than 5 feet (1.5 m) o.c.
5. Provide a hook at each change in direction.

Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

DD. Set metal floor boxes level and flush with finished floor surface.

EE. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Firestop and seal per Division 07.

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 271323 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Community College of Rhode Island Information Technology Standards.

1.2 SUMMARY

A. Section Includes:
1. 850 nanometer laser-optimized 50/125 micrometer multimode optical fiber cable (OM3).
2. Optical fiber cable connecting hardware, patch panels, and cross-connects.
3. Cabling identification products.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

C. RCDD: Registered Communications Distribution Designer.

D. AHJ: Authorities Having Jurisdiction

E. NRTL: Nationally Recognized Testing Laboratory

1.4 OPTICAL FIBER BACKBONE CABLING DESCRIPTION

A. Optical fiber backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.

4. Wiring diagrams to show typical wiring schematics including the following:

    a. Telecommunications rooms plans and elevations.
    b. Telecommunications pathways.
    c. Telecommunications system access points.
    d. Telecommunications grounding system.
    e. Cross-connects.
    f. Patch panels.
    g. Patch cords.

5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

C. Optical fiber cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For RCDD, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Product Certificates: For each type of product.

D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For optical fiber cable, splices, and connectors to include in maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Patch-Panel Units: One of each type.
2. Fiber enclosure. One of each type
3. Plugs: Ten of each type.
4. Jacks: Ten of each type.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer shall have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings, by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

1.11 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.13 WARRANTY

A. Optical fiber cabling twenty-five (25) Year Warranty for premise communications wiring.

1. The systems integrator shall provide proof that they are authorized and certified, in good standing, to offer a 25-year warranty.
2. The warranty shall include connecting hardware products and installed cable as part of the optical fiber cabling system.
3. The optical fiber cabling system shall include:
   a. Termination enclosures
   b. Backbone cabling
   c. The connecting hardware in the horizontal cross-connect
   d. The equipment cords.
   e. The patch cords for the horizontal cross-connect.
4. The warranty system performance shall guarantee that:
   a. The optical fiber cabling system shall be free from defects in materials and workmanship, for duration of the warranty.
   b. The optical fiber cabling system shall support any current or future application ratified by IEE, ANSI, ISO, designed to operate compliant optical fiber draft or standard in effect at the time of the installation, for the duration of the warranty.

5. If the optical fiber cabling system is determined to be defective within the scope of this warranty, the product found to be non-conforming shall be repaired or replaced under this warranty.

6. Optical fiber cabling system shall be tested per the manufacturer’s warranty requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

D. Grounding: Comply with TIA-607-B.

2.2 MULTIMODE OPTICAL FIBER CABLE (OM3)

A. Description: Multimode, 50/125-micrometer, indicated on drawings, conductive tight buffer, optical fiber cable. Refer to drawings for additional information.

B. Standards:

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with TIA-492AAAD for detailed specifications.

C. Conductive cable shall be aluminum armored type.

D. Maximum Attenuation: 3.0 dB/km at 850 nm; 1.0 dB/km at 1300 nm.

E. Minimum Overfilled Modal Bandwidth-length Product: 1500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

F. Jacket:

1. Jacket Color: Aqua.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-D.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

G. Listed and labeled by an NRTL acceptable to AHJ as complying with UL 444, UL 1651, and NFPA 70 for the following types:

2.3 OPTICAL FIBER CABLE HARDWARE

A. All Hardware and components shall be per Community College of Rhode Island Information Technology Standards.

B. Standards:

1. Comply with Fiber Optic Connector Intermate ability Standard (FOCIS) specifications of the TIA-604 series.
2. Comply with TIA-568-C.3.

C. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

D. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.

E. Connector Type: Type LC complying with TIA-604-10-B connectors.

F. Plugs and Plug Assemblies:

1. Male; color-coded modular telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.3 dB.
3. Marked to indicate transmission performance.

G. Jacks and Jack Assemblies:

1. Female; quick-connect, simplex and duplex; fixed telecommunications connector designed for termination of a single optical fiber cable.
2. Insertion loss not more than 0.3 dB.
3. Marked to indicate transmission performance.
4. Designed to snap-in to a faceplate.

2.4 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Comply with TIA-607-B.

2.5 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.6 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test multimode optical fiber cables according to TIA-526-14-B and TIA-568-C.3.

C. Factory test pre-terminated optical fiber cable assemblies according to TIA-526-14-B and TIA-568-C.3.

D. Cable shall be considered defective if it does not pass tests and inspections. Cabling shall be replaced with new non-defected cabling at no additional cost to the owner.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider. Coordinate exact routing and termination within the entrance facility.

3.2 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF OPTICAL FIBER BACKBONE CABLES

A. Comply with NECA 1, NECA 301, and NECA/BICSI 568.

B. General Requirements for Optical Fiber Cabling Installation:

1. Comply with TIA-568-C.1 and TIA-568-C.3.
2. Comply with BICSI ITSIMM, Ch. 6, "Cable Termination Practices."
3. Terminate all cables; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
4. Cables shall not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
6. Bundle, lace, and train cable to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable at no additional cost to the owner.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. In the communications equipment room, provide a 10-foot- (3-m-) long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 4, "Pulling Cable." Monitor cable pull tensions and cable manufacturer’s recommended installation methods.
11. Cable shall be terminated on connecting hardware that is rack, cabinet or wall mounted enclosures as indicated on drawings.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Group connecting hardware for cables into separate logical fields.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI ITSIMM, "Firestopping" Chapter.

3.5 GROUNDING

A. Install grounding according to BICSI ITSIMM, "Grounding (Earthing), Bonding, and Electrical Protection" Chapter.

B. Comply with TIA-607-B and NECA/BICSI-607.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

1. Administration Class: Class 2.
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration.

C. Comply with requirements in Section 271523 "Communications Optical Fiber Horizontal Cabling" for cable and asset management software.

D. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

F. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
4. Label each unit and field within distribution racks and frames.
5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA 606-B, for the following:

1. Flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections:

1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Optical Fiber Cable Tests:

   a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
   b. Link End-to-End Attenuation Tests:

      1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-B, Method B, One Reference Jumper.
      2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than those calculated according to equation in TIA-568-C.1.

F. Clean and inspect all fiber optic connector end faces per IEC 61300-3-35 “Basic Test and Measurement Procedures Standard for Fiber Optic Interconnecting Devices and Passive Components”.

G. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

H. Remove and replace cabling where test results indicate that it does not comply with specified requirements.

I. End-to-end cabling will be considered defective if it does not pass tests and inspections.

J. Prepare test and inspection reports.

END OF SECTION

SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Community College of Rhode Island Information Technology Standards.

1.2 SUMMARY

A. Section Includes:

1. Category 6a twisted pair cable.
2. Twisted pair cable hardware, including plugs and jacks.
3. Cabling identification products.
4. Grounding provisions for twisted pair cable.
5. Source quality control requirements for twisted pair cable.

1.3 DEFINITIONS

A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

B. EMI: Electromagnetic interference.

C. FTP: Shielded twisted pair.

D. F/FTP: Overall foil screened cable with foil screened twisted pair.

E. F/UTP: Overall foil screened cable with unscreened twisted pair.

F. IDC: Insulation displacement connector.

G. LAN: Local area network.

H. Jack: Also commonly called an "outlet," it is the fixed, female connector.

I. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.

J. NRTL: Nationally Recognized Testing Laboratory

K. AHJ: Authorities Having Jurisdiction

L. RCDD: Registered Communications Distribution Designer.

M. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

N. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

O. S/FTP: Overall braid screened cable with foil screened twisted pair.

P. S/UTP: Overall braid screened cable with unscreened twisted pairs.

Q. UTP: Unscreened (unshielded) twisted pair.

1.4 BIDDING REQUIREMENTS

A. Installer Qualifications, submit on all the following:

1. System installer shall have on staff a RCDD (registered communication distribution designer) certified by BICSI (Building Industry Consulting Service International).
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician Level 2 Installer, who shall be present at all time when Work of this Section is performed at Project site.
3. System Installer shall hold relevant certifications for all products and materials required by the scope of this project beyond those listed above.
4. System Installer shall carry all state, federal and local licenses.
5. System Installer shall carry OSHA 10 or OSHA 30 certification.
6. On a separate sheet, list 3-5 structured cabling projects the contractor's organization has completed or is in progress of completing, the past 5 years. Projects shall utilize the basis of design products and/or systems.
   a. Name of project:
   b. Project summary:
   c. Contact name:
   d. Contract amount:
   e. Date of completion:
   f. Percentage of the cost of the work performed with the contractor's own forces:

B. The Contractor shall not employ a Subcontractor to fulfill any of the duties as herein specified unless expressly allowed by the general conditions of the project.

1.5 COPPER HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the equipment outlets to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Reviewed and stamped by RCDD.

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration Drawings and printouts.
3. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:

    a. Telecommunications rooms plans and elevations.
    b. Telecommunications pathways.
    c. Telecommunications system access points.
    d. Telecommunications grounding system.
    e. Telecommunications conductor drop locations.
    f. Typical telecommunications details.
    g. Mechanical, electrical, and plumbing systems.

C. Twisted pair cable testing plan.

D. Samples: For telecommunications jacks and plugs, in specified finish, one for each type and configuration and faceplates for color selection and evaluation of technical features.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For RCDD, installation supervisor, and field inspector.

B. Product Certificates: For each type of product.

C. Source quality-control reports.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Connecting Blocks: One of each type.
2. Faceplates: One of each type.
3. Jacks: Ten of each type.
4. Patch-Panel Units: One of each type.
5. Plugs: Ten of each type.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer shall have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and cabling administration Drawings, by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits using a wire map / continuity tester.

1.12 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.13 COORDINATION

A. All products and materials shall be per Community College of Rhode Island Standard as provided by the school.

B. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.14 WARRANTY

A. UTP Cabling twenty-five (25) Year Warranty for premise communications wiring.

1. The systems integrator shall provide proof that they are authorized and certified, in good standing, to offer a 25-year warranty.
2. The warranty shall include all connecting hardware products and installed cable as part of the structural cabling system.
3. The structural cabling system shall include:
   a. Work area outlets
   b. Horizontal cable
   c. The connecting hardware in the horizontal cross-connect
   d. The equipment cord at the work area
   e. The patch cord for the horizontal cross-connect.
4. The warranty system performance shall guarantee that:
   a. The structural cabling system shall be free from defects in materials and workmanship, for duration of the warranty.
   b. The structural cabling system shall support any current or future application ratified by IEE, ANSI, ISO, designed to operate compliant category 3, 5, 5e, 6, 6e, or 6a draft or standard in effect at the time of the installation, for the duration of the warranty.

5. If the structural cabling system is determined to be defective within the scope of this warranty, the product found to be non-conforming shall be repaired or replaced, at no additional cost to the owner, under this warranty.
6. Structural cabling system shall be tested per the manufacturer’s warranty requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-1.D, when tested according to test procedures of this standard.

B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

C. Grounding: Comply with TIA-607-B.

2.2 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

1. Communications, Plenum Rated: Type CMP complying with UL 1685 or Type CMP in listed plenum communications raceway.
2. Communications, Plenum Rated: Type CM, Type CMG, Type CMP, Type CMR, or Type CMX in metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. RoHS compliant.

2.3 CATEGORY 6a TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500MHz.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings and per Community College of Rhode Island Standards.

C. Standard: Comply with TIA-568-C.2 for Category 6a cables.

D. Conductors: 100-ohm, 23 AWG solid copper.

E. Shielding/Screening: As indicated on drawings.

F. Cable Rating: As indicated on drawings.

G. Jacket: As indicated on drawings fluoropolymer.

2.4 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings and per Community College of Rhode Island Standards.

C. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of As indicated on drawings.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

D. Patch Panel: Unloaded modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.

1. Features:

a. Universal T568A and T568B wiring labels.
b. Labeling areas adjacent to conductors.
c. Replaceable connectors.
d. 24 or 48 ports.

2. Construction: 16-gauge steel and mountable on 19-inch (483 mm) equipment racks.
3. Number of Jacks per Field: One colored convector for each available port.

E. Patch Cords: Shall match horizontal cabling manufacturer, factory-made, four-pair cables in 36-inch (900-mm), 48-inch (1200-mm) lengths; terminated with an eight-position modular plug at each end and 60-inch (1500 mm).

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall match color code of connecting link.

F. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Standard: Comply with TIA-568-C.2.
3. Marked to indicate transmission performance.

G. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Designed to snap-in to a patch panel or faceplate.
3. Standard: Comply with TIA-568-C.2.
4. Marked to indicate transmission performance.

H. Faceplate:
1. As indicated on drawings
2. Per Community College of Rhode Island Standards.
3. Plastic Faceplate: High-impact plastic. Coordinate color with Community College of Rhode Island IT Department.
4. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.

I. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.6 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

B. Comply with TIA-607-B.

2.7 SOURCE QUALITY CONTROL

A. Factory test cables on reels according to TIA-568-1.D.

B. Factory test twisted pair cables according to TIA-568-C.2.

C. Cable shall be considered defective if it does not pass tests and inspections. Cabling shall be replaced with new non-defected cabling at no additional cost to the owner.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, attics, and gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables, except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."

B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF PATHWAYS

A. Comply with Section 270528 "Pathways for Communications Systems."

B. Drawings indicate general arrangement of pathways and fittings.

3.3 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

A. Comply with NECA 1 and NECA/BICSI 568.

B. General Requirements for Cabling:

1. Comply with TIA-568-0.D, TIA-568-1.D, and TIA-568-C.2.
2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Do not untwist twisted pair cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. MUTOA shall not be used as a cross-connect point.
7. Consolidation points shall not be used.
8. Cables shall not be spliced.
9. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
10. Cable ties shall not be accepted; all cables shall be secured with fabric hook and loop rated for environment being installed within.
11. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
12. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual , Ch. 5, "Cable Installation," "Cable Termination" Section. Use lacing bars and distribution spools.
13. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
14. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
15. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
16. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Cabling Installation," "Pulling Cable" Section. Monitor cable pull tensions.
17. Cables shall be trained, bundled, and separated by color in all exposed areas. Cables shall be bundled with fabric hook and loop that matches cabling color.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
4. Cables shall be trained, bundled, and separated by color in all exposed areas. Cables shall be bundled with fabric hook and loop that matches cabling color.

D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRESTOPPING

A. Comply with requirements in Division 07 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with "Firestopping Systems" Chapter in BISCI's "Telecommunications Distribution Methods Manual."

3.5 GROUNDING

A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."

B. Comply with TIA-607-B and NECA/BICSI-607.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.

D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B.

1. Administration Class: Class 1, Class 2, Class 3.
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration.

C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

E. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.

   a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
   b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

1. Cable labels shall use flexible vinyl or polyester that flexes as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections:

1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-1.D.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but before cross-connection.

   a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy

(Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

C. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

D. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Refer to section 271710 “Testing, Identification and Administration of Balanced Twisted Pair Infrastructure” for testing requirements.

END OF SECTION

SECTION 27 17 00 - TESTING, IDENTIFICATION AND ADMINISTRATION OF FIBER INFRASTRUCTURE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Community College of Rhode Island Information Technology Standards.

1.2 WORK INCLUDED

A. Provide all labor, materials, tools, field-test instruments and equipment required for the complete testing, identification and administration of the work called for in the Contract Documents.

B. In order to conform to the overall project event schedule, the cabling contractor shall survey the work areas and coordinate cabling testing with other applicable trades. The cabling contractor shall carry out testing in accordance with this document for all new and temporary fiber systems. Testing shall be done at the end of every phasing period. Coordinate all phasing requirements with General Contractor/Owner prior to start of any work.

C. In addition to the tests detailed in this document, the contractor shall notify the Owner's representative or engineer on record of any additional tests that are deemed necessary to guarantee a fully functional system. The contractor shall carry out and record any additional measurement results at no additional charge.

D. The Cabling Contractor shall test all existing cabling systems within the building prior to start of any work. Any link or channel that fails requirements described in Part 3 shall be diagnosed and brought to the Owner's representative or engineer on record attention. The Contractor shall carry out and document any corrective actions at no additional charge.

1.3 SCOPE

A. This Section includes the minimum requirements for the test certification, identification and administration of backbone and horizontal optical fiber cabling.

B. This Section includes minimum requirements for:

1. Fiber optic test instruments
2. Fiber optic testing
3. Identification
   a) Labels and labeling
4. Administration
   a) Test results documentation
   b) As-built drawings

C. Testing shall be carried out in accordance with this document. This includes testing the attenuation and polarity of the installed cable with an optical loss test set (OLTS) and the installed condition of the cabling system and its components with an optical time domain reflectometer (OTDR). The condition of the fiber end faces shall also be verified.

D. Testing shall be performed on each cabling link (connector to connector).

E. Testing shall be performed on each cabling channel (equipment to equipment) that is identified by the owner.

1. Testing shall not include any active devices or passive devices within the link or channel other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.

F. All tests shall be documented including OLTS dual wavelength attenuation measurements for multimode and singlemode links and channels and OTDR traces and event tables for multimode and singlemode links and channels and multifiber polarity verification for multimode and singlemode links and channels.

1. Optionally documentation shall also include optical length measurements and pictures of the connector end face.

G. Testing shall be performed in accordance with this document. Multi-Fiber cables that are factory pre-terminated and brought onto the site shall have optical loss testing performed prior to install to confirm Polarity and Skew. After installation and prior to turnover TIA-568-C certification testing shall be performed to confirm the individual fibers within each cable performs to the 40G-Base-XX performance of the channel and shown on each test report.

1.4 QUALITY ASSURANCE

A. All testing procedures and field-test instruments shall comply with applicable requirements of:

1. ANSI Z136.2, ANS For Safe Use Of Optical Fiber Communication Systems Utilizing Laser Diode And LED Sources
2. ANSI/EIA/TIA-455-50B, Light Launch Conditions For Long-Length Graded-Index Optical Fiber Spectral Attenuation Measurements
3. ANSI/TIA/EIA-455-59A, Measurement of Fiber Point Discontinuities Using an OTDR.
4. ANSI/TIA/EIA-455-60A, Measurement of Fiber or Cable Length Using an OTDR.
5. ANSI/TIA/EIA-455-61A, Measurement of Fiber or Cable Attenuation Using an OTDR.
6. ANSI/TIA/EIA-526-7, Optical Power Loss Measurements of Installed Singlemode Fiber Cable Plant.
7. ANSI/TIA-526-14-B, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant; IEC 61280-4-1 edition 2, Fibre-Optic Communications Subsystem Test Procedure- Part 4-1: Installed cable plant- Multimode attenuation measurement.
8. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises.
9. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard.
10. ANSI/TIA-606-B, Administration Standard for Commercial Telecommunications Infrastructure, including the requirements specified by the customer, unless the customer specifies their own labeling requirements.

B. The technicians shall have successfully attended the following training programs and have obtained a certificate as proof thereof shall execute the tests. These certificates shall be issued by the following organizations or an equivalent organization:

1. Manufacturer of the fiber optic cable and the fiber optic connectors.
2. Manufacturer of the test equipment used for the field certification.
3. Training organizations (e.g., BICSI, A Telecommunications Association headquarters in Tampa, Florida; ACP [Association of Cabling Professionals™] Cabling Business Institute located in Dallas, Texas)

C. The Owner's representative and the on record engineer shall be invited to witness and/or review field-testing.

1. The Owner's representative and the on record engineer shall be notified of the start date of the testing phase five (5) business days before testing commences.
2. The Owner's representative and/or the on record engineer will select a random sample of 5% of the installed links. The Owner's representative and/or the on record engineer shall test these randomly selected links and the results are to be stored in accordance with Part 3 of this document. The results obtained shall be compared to the data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the representative shall repeat 100% testing at no cost to the Owner.
3. The tester used shall be bought specifically for this job and turned over to owner at completion of job.

1.5 SUBMITTALS

A. Manufacturers catalog sheets and specifications for fiber optic field-test instruments including optical loss test sets (OLTS; power meter and source), multifiber, optical time domain reflectometer (OTDR) and inspection scope.

B. A schedule (list) of all optical fibers to be tested.

C. Sample test reports.

1.6 ACCEPTANCE OF TEST RESULTS

A. Unless otherwise specified by the Owners representative or the on record engineer, each cabling link shall be in compliance with the following test limits:

1. Optical loss testing

a) Multimode and Singlemode links

1) The link attenuation shall be calculated by the following formulas as specified in ANSI/TIA-568-C.0.

(i) Link Attenuation (dB) = Cable_Attn (dB) + Connector_Attn (dB) + Splice_Attn (dB)
(ii) Cable_Attn (dB) = Attenuation_Coefficient (dB/km) * Length (Km)
(iii) Connector_Attn (dB) = number_of_connector_pairs * connector_loss (dB)
(iv) Maximum allowable connector_loss = 0.75 dB
(v) Splice_Attn (dB) = number_of_splices * splice_loss (dB)
(vi) Maximum allowable splice_loss = 0.3 dB
(vii) The values for the Attenuation_Coefficient (dB/km) are listed in the table below:

Type of Optical Fiber	Wavelength (nm)	Attenuation coefficient (dB/km)	Wavelength (nm)	Attenuation coefficient (dB/km)
Multimode 62.5/125 µm	850	3.5	1300	1.5
Multimode 50/125 µm	850	3.5	1300	1.5
Single-mode (Inside plant)	1310	1.0	1550	1.0
Single-mode (Outside plant)	1310	0.5	1550	0.5

2. OTDR testing
   a) Reflective events (connections) shall not exceed 0.75 dB.
   b) Non-reflective events (splices) shall not exceed 0.3 dB.
3. Magnified end face inspection
   a) Fiber connections shall be visually inspected for end face quality.
   b) Scratched, pitted or dirty connectors shall be diagnosed and corrected.

B. All installed cabling links and channels shall be field-tested and pass the test requirements and analysis as described in Part 3. Any link or channel that fails these requirements shall be diagnosed and corrected. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected link or channel meets performance requirements. The final and passing result of the tests for all links and channels shall be provided in the test results documentation in accordance with Part 3.

C. All test results shall be approved by the Owner's representative or the on record engineer at the end of every phasing period.

D. Acceptance of the test results shall be given in writing after the project is fully completed and tested in accordance with Contract Documents and to the satisfaction of the Owner.
Note: High Bandwidth applications such as 1000BASE-SX, 10GBASE-SR, and FC1200 impose stringent channel loss limits. Where practical, certification should consider loss length limits that meet maximum channel (transmitter to receiver) loss.

Performance specification for MM fiber at 850 nm

Fiber Type		Bandwidth	1000BASE-SX		10GBASE-SR		FibreChannel 1200-MX-SN-I	
	µm	(MHz•Km)	Length (m)	Loss (dB)	Length (m)	Loss (dB)	Length (m)	Loss (dB)
OM 1	62.5	200	275	2.38	33	2.5	33	2.4
OM 2	50	500	550	3.56	82	2.3	82	2.2
OM 3	50	2000	N/A	N/A	300	2.6	300	2.6
OM 4	50	47000	N/A	N/A	400	2.9	N/A	N/A

PART 2 - PRODUCTS

2.1 OPTICAL FIBER CABLE TESTERS

A. The field-test instrument shall be within the calibration period recommended by the manufacturer.

B. Optical loss test set (OLTS)

1. Multimode optical fiber light source
   a) Provide dual LED light sources with central wavelengths of 850 nm (±30 nm) and 1300 nm (±20 nm)
   b) Output power of –20 dBm minimum.
   c) The light source shall meet the Encircled Flux launch requirements of ANSI/TIA-526-14-B.
   d) Acceptable manufacturers
      1) Fluke Networks
2. Singlemode optical fiber light source
   a) Provide dual laser light sources with central wavelengths of 1310 nm (±20 nm) and 1550 nm (±20 nm).
   b) Output power of –10 dBm minimum.
   c) Acceptable manufacturers
      1) Fluke Networks
3. Power Meter
   a) Provide 850 nm, 1300/1310 nm, and 1550 nm wavelength test capability.
   b) Power measurement uncertainty of ± 0.25 dB.
   c) Store reference power measurement.
   d) Save at least 100 results in internal memory.
   e) PC interface (serial or USB).
   f) Acceptable manufacturers
      1) Fluke Networks
4. Optional length measurement
   a) It is preferable to use an OLTS that is capable of measuring the optical length of the fiber using time-of-flight techniques.

C. Optical Time Domain Reflectometer (OTDR)

1. Shall have a bright, color transmissive LCD display with backlight.
2. Shall have rechargeable Li-Ion battery for 8 hours of normal operation.
3. Weight with battery and module of not more than 4.5 lb and volume of not more 200 in^3.
4. Internal non-volatile memory and removable memory device with at least 16 MB capacity for results storage.
5. Serial and USB ports to transfer data to a PC.
6. Multimode OTDR
   a) Wavelengths of 850 nm (± 20 nm) and 1300 nm (± 20 nm).
   b) Event dead zones of 3.7 m maximum at 850 nm and 1300 nm.
   c) Attenuation dead zones of 10 m maximum at 850 nm and 13 m maximum at 1300 nm.
   d) Distance range not less than 2000 m.

e) Dynamic range at least 10 dB at 850 nm and 1300 nm

7. Singlemode OTDR

a) Wavelengths of 1310 nm (± 20 nm) and 1550 nm (± 20 nm).
b) Event dead zones of 3.5 m maximum at 1310 nm and 1550 nm.
c) Attenuation dead zones of 10 m maximum at 1310 nm and 12 m maximum at 1550 nm.
d) Distance range not less than 10000 m.
e) Dynamic range at least 10 dB at 1310 nm and 1550 nm

8. Acceptable manufacturers

a) Fluke Networks

D. Fiber Microscope

1. Magnification of 200X or 400X for end face inspection
2. Acceptable manufacturers

a) Fluke Networks

3. Optional requirements

a) Video camera systems are preferred.
b) Camera probe tips that permit inspection through adapters are preferred.
c) It is preferable to use test equipment capable of saving and reporting the end face image.

E. Integrated OLTS, OTDR and fiber microscope

1. Test equipment that combines into one instrument an OLTS, an OTDR and a fiber microscope may be used.

2. Acceptable manufacturers

a) Fluke Networks.

2.2 IDENTIFICATION

A. Labels

1. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
2. Shall be preprinted using a mechanical means of printing (e.g., laser printer).
3. Where used for cable marking, provide vinyl substrate with a white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable. If cable jacket is white, provide cable label with printing area that is any other color than white, preferably orange or yellow – so that the labels are easily distinguishable.
4. Where insert type labels are used provide clear plastic cover over label.
5. Provide plastic warning tape 6 inches wide continuously printed and bright colored 18” above all direct buried services, underground conduits and duct-banks.
6. Acceptable Manufacturers:
   a) Silver Fox
   b) W.H. Brady
   c) Brothers

2.3 ADMINISTRATION

A. Administration of the documentation shall include test results of each fiber link and channel.

B. The test result information for each link shall be recorded in the memory of the field-test instrument upon completion of the test.

C. The test result records saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records.

PART 3 – EXECUTION

3.1 GENERAL

A. All tests performed on optical fiber cabling that use a laser or LED in a test set shall be carried out with safety precautions in accordance with ANSI Z136.2.

B. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to field-testing. Any testing performed on incomplete systems shall be redone on completion of the work.

3.2 OPTICAL FIBER CABLE TESTING

A. Field-test instruments shall have the latest software and firmware installed.

B. Link and channel test results from the OLTS and OTDR shall be recorded in the test instrument upon completion of each test for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.

C. Fiber end faces shall be inspected at 200X or 400X magnification. 200X magnification is suitable for inspecting multimode and singlemode fibers. 400X magnification may be used for detailed examination of singlemode fibers. Scratched, pitted or dirty connectors shall be diagnosed and corrected.

1. It is preferable that the end face images be recorded in the memory of the test instrument for subsequent uploading to a PC and reporting.

D. Testing shall be performed on each cabling segment (connector to connector).

E. Testing shall be performed on each cabling channel (equipment to equipment) that is planned for use per the owner's instructions.

F. Testing of the cabling shall be performed using high-quality test cords of the same fiber type as the cabling under test. The test cords for OLTS testing shall be between 1 m and 5 m in length. The test cords for OTDR testing shall be approximately 100 m for the launch cable and at least 25 m for the receive cable.

G. Optical loss testing

1. Horizontal/Backbone link

a) Multimode links shall be tested at 850 nm and 1300 nm in accordance with ANSI/TIA-526-14-B, one-cord reference method.

b) Singlemode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, One Reference Jumper equivalent method.

c) Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.

H. OTDR Testing

1. Fiber links shall be tested at the appropriate operating wavelengths for anomalies and to ensure uniformity of cable attenuation and connector insertion loss.

   a) Multimode: 850 nm and 1300 nm

   b) Singlemode: 1310 nm and 1550 nm

2. Each fiber link and channel shall be tested in both directions.
3. A launch cable shall be installed between the OTDR and the first link connection.
4. A receive cable shall be installed after the last link connection.

I. Magnified End face Inspection

1. Fibers shall be inspected at 250X or 400X magnification. 250X magnification is suitable for inspecting multimode and singlemode fibers. 400X magnification may be used for detailed examination of singlemode fibers.

J. Length Measurement

1. The length of each fiber shall be recorded.
2. It is preferable that the optical length be measured using an OLTS or OTDR.

K. Polarity Testing

1. Paired duplex fibers in multi-fiber cables shall be tested to verify polarity in accordance with Clause E.5.3 of ANSI/TIA-568-C.0. The polarity of the paired duplex fibers shall be verified using an OLTS.
2. Singlemode and multimode MPO trunk cables, shall be tested to verify polarity in accordance with ANSI/TIA-568-C.O. The polarity of the MPO trunk fibers shall be verified using a Fluke Multifiber Pro.

L. All test results shall be approved by the Owner's representative or the on record engineer at the end of every phasing period.

3.3 IDENTIFICATION

A. Labeling

1. Labeling shall conform to the requirements specified within ANSI/TIA-606-B or to the requirements specified by the Owner or the Owner's representative.

3.4 ADMINISTRATION

A. Test results documentation

1. Test results saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of the test records. These test records shall be uploaded to the PC unaltered, i.e., "as saved in the field-test

instrument". The file format, CSV (comma separated value), does not provide adequate protection of these records and shall not be used.

2. The test results documentation shall be available for inspection by the Owner or the Owner's representative during the installation period and shall be passed to the Owner's representative within 5 working days of completion of tests on cabling served by a telecommunications room or of backbone cabling. The installer shall retain a copy to aid preparation of as-built information.
3. The database for the complete project, including twisted-pair copper cabling links, if applicable, shall be stored and delivered on CD-ROM prior to Owner acceptance of the building. This CD-ROM shall include the software tools required to view, inspect, and print any selection of the test reports.
4. Circuit IDs reported by the test instrument should match the specified label ID (see 3.3 of this Section).
5. The detailed test results documentation data is to be provided in an electronic database for each tested optical fiber and shall contain the following information

   a) The identification of the customer site as specified by the end-user
   b) The name of the test limit selected to execute the stored test results
   c) The name of the personnel performing the test
   d) The date and time the test results were saved in the memory of the tester
   e) The manufacturer, model and serial number of the field-test instrument
   f) The version of the test software and the version of the test limit database held within the test instrument
   g) The fiber identification number
   h) The length for each optical fiber

      1) Optionally the index of refraction used for length calculation when using a length capable OLTS

   i) Test results to include OLTS attenuation link and channel measurements at the appropriate wavelength(s) and the margin (difference between the measured attenuation and the test limit value).
   j) Test results to include OTDR link and channel traces and event tables at the appropriate wavelength(s).
   k) The length for each optical fiber as calculated by the OTDR.
   l) The overall Pass/Fail evaluation of the link-under-test for OLTS and OTDR measurements.
   m) A picture or image of each fiber end-face
   n) A pass/fail status of the end-face based upon visual inspection.

B. Record copy and as-built drawings

1. Provide record copy drawings periodically through out the project as requested by the Construction Manager or Owner, and at end of the project on CD-ROM. Record copy drawings at the end of the project shall be in CAD format and include notations reflecting the as built conditions of any additions to or variation from the drawings provided such as, but not limited to cable paths and termination point. CAD drawings are to incorporate test data imported from the test instruments.
2. The as-built drawings shall include, but are not limited to block diagrams, frame and cable labeling, cable termination points, equipment room layouts and frame installation details. The as-builts shall include all field changes made up to construction completion:

   a) Field directed changes to pull schedule.
   b) Field directed changes to cross connect and patching schedule.
   c) Horizontal cable routing changes.

d) Backbone cable routing or location changes.
e) Associated detail drawings.

END OF SECTION

SECTION 27 17 10 - TESTING, IDENTIFICATION AND ADMINISTRATION OF BALANCED TWISTED PAIR INFRASTRUCTURE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Community College of Rhode Island Information Technology Standards.

1.2 WORK INCLUDED

A. Provide all labor, materials, tools, field-test instruments and equipment required for the complete testing, identification and administration of the work called for in the Contract Documents.

B. In order to conform to the overall project event schedule, the cabling contractor shall survey the work areas and coordinate cabling testing with other applicable trades.

C. In addition to the tests detailed in this document, the contractor shall notify the Owner's representative or Engineer of Record of any additional tests that are deemed necessary to guarantee a fully functional system. The contractor shall carry out and record any additional measurement results at no additional charge.

1.3 SCOPE

A. This Section includes the minimum requirements for the test certification, identification and administration of horizontal balanced twisted pair cabling.

B. This Section includes minimum requirements for:

1. Copper cabling test instruments
2. Copper cabling testing
3. Identification
   a) Labels and labeling
4. Administration
   a) Test results documentation
   b) As-built drawings

C. Testing shall be carried out in accordance with this document.

D. Testing shall be performed on each cabling link. (100% testing)

E. All tests shall be documented.

1.4 QUALITY ASSURANCE

A. All testing procedures and field-test instruments shall comply with applicable requirements of:

1. ANSI/TIA-1152, Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
2. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises.
3. ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard
4. ANSI/TIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standards.
5. ANSI/TIA-606-B, Administration Standard for Commercial Telecommunications Infrastructure, including the requirements specified by the customer, unless the customer specifies their own labeling requirements.

B. The technicians shall have successfully attended the following training programs and have obtained a certificate as proof thereof shall execute the tests. These certificates shall be issued by the following organizations or an equivalent organization:

1. Manufacturer of the connectors and cable.
2. Manufacturer of the test equipment used for the field certification.
3. Training organizations (e.g., BICSI, A Telecommunications Association headquarters in Tampa, Florida; ACP [Association of Cabling Professionals™] Cabling Business Institute located in Dallas, Texas)

C. The Owner's representative or Engineer of Record shall be invited to witness and/or review field-testing.

1. The Owner's representative or Engineer of Record shall be notified of the start date of the testing phase five (5) business days before testing commences.
2. The Owner's representative or Engineer of Record will select a random sample of 5% of the installed links. The Owner's representative or Engineer of Record shall test these randomly selected links and the results are to be stored in accordance with Part 3 of this document. The results obtained shall be compared to the data provided by the installation contractor. If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the representative shall repeat 100% testing at no cost to the Owner.
3. The tester used shall be bought specifically for this job and turned over to owner at completion of job.

1.5 SUBMITTALS

A. Manufacturers catalog sheets and specifications for the test equipment.

B. A schedule (list) of all balanced twisted-pair copper links to be tested.

C. Sample test reports.

1.6 ACCEPTANCE OF TEST RESULTS

A. Unless otherwise specified by the Owner or the Owners representative, each cabling link shall be in tested for:

1. Wire Map
2. Length
3. Propagation Delay
4. Delay Skew
5. DC Loop Resistance – recorded for information only

6. DC Resistance Unbalance – recorded for information only
7. Insertion Loss
8. NEXT (Near-End Crosstalk)
9. PS NEXT (Power Sum Near-End Crosstalk)
10. ACR-N (Attenuation to Crosstalk Ratio Near-End) – recorded for information only
11. PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End) – recorded for information only
12. ACR-F (Attenuation to Crosstalk Ratio Far-End)
13. PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End)
14. Return Loss
15. TCL (Transverse Conversion Loss) – recorded for information only
16. ELTCTL (Equal Level Transverse Conversion Transfer Loss) – recorded for information only
17. PS ANEXT (Power Sum Alien Near-End Crosstalk) – sampled per section 3.2
18. Average PS ANEXT (Average Power Sum Alien Near-End Crosstalk) – sampled per section 3.2
19. PS AACR-F (Power Sum Alien Attenuation to Crosstalk Ratio Far-End) – sampled per section 3.2
20. Average PS AACR-F (Average Power Sum Alien Attenuation to Crosstalk Ratio Far-End) – sampled per section 3.2

B. All installed cabling Permanent Links shall be field-tested and pass the test requirements and analysis as described in Part 3. Any Permanent Link that fails these requirements shall be diagnosed and corrected. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected Permanent Link meets performance requirements. The final and passing result of the tests for all Permanent Links shall be provided in the test results documentation in accordance with Part 3.

C. All test results shall be approved by the Owner's representative or the on record engineer at the end of every phasing period.

D. Acceptance of the test results shall be given in writing after the project is fully completed and tested in accordance with Contract Documents and to the satisfaction of the Owner.

PART 2 - PRODUCTS

2.1 BALANCED TWISTED-PAIR CABLE TESTERS

A. The field-test instrument shall be within the calibration period recommended by the manufacturer, typically 12 months.

B. Certification tester
   1. Accuracy
      a) Level IIIe accuracy in accordance with ANSI/TIA-1152
      b) Independent verification of accuracy
      c) Acceptable manufacturers
         1) Fluke Networks
         2) Or approved equal
   2. Permanent Link Adapters
      a) RJ45 plug must meet the requirements for NEXT, FEXT and Return Loss in accordance with ANSI/TIA-568-C.2 Annex C

b) Twisted pair Category 5e, 6, 6A, 7 or 7_A cords are not permitted as their performance degrades with use and can cause false Return Loss failures

3. Results Storage
   a) Must be capable of storing > 10,000 results for all measurements found in 2.1.B.4 below

4. Measurement capabilities
   a) Wire Map
   b) Length
   c) Propagation Delay
   d) Delay Skew
   e) DC Loop Resistance
   f) DC Resistance Unbalance
   g) Insertion Loss
   h) NEXT (Near-End Crosstalk)
   i) PS NEXT (Power Sum Near-End Crosstalk)
   j) ACR-N (Attenuation to Crosstalk Ratio Near-End)
   k) PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End)
   l) ACR-F (Attenuation to Crosstalk Ratio Far-End)
   m) PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End)
   n) Return Loss
   o) TCL (Transverse Conversion Loss)
   p) ELTCTL (Equal Level Transverse Conversion Transfer Loss)
   q) Time Domain Reflectometer
   r) Time Domain Xtalk Analyzer
   s) PS ANEXT (Power Sum Alien Near-End Crosstalk)
   t) Average PS ANEXT (Average Power Sum Alien Near-End Crosstalk)
   u) PS AACR-F (Power Sum Alien Attenuation to Crosstalk Ratio Far-End)
   v) Average PS AACR-F (Average Power Sum Alien Attenuation to Crosstalk Ratio Far-End)

C. PC Software

1. Windows® based.
2. Must show when 3 dB and 4 dB rules are applied
3. Re-certification capability, where results must have their Cable IDs suffixed with (RC).
4. Built in PDF export – no additional third party software permitted.
5. Built-in statistical analysis.

2.2 IDENTIFICATION

A. Labels

1. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
2. Cable identification shall comply with CCRI (Community College of Rhode Island) Building/Facilities standards.
3. Shall be preprinted using a mechanical means of printing (e.g., laser printer).
4. Where used for cable marking, provide vinyl substrate with a white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable. If cable jacket is white, provide cable label with printing area that is any other color than white, preferably orange or yellow – so that the labels are easily distinguishable.
5. Where insert type labels are used provide clear plastic cover over label.

6. Provide plastic warning tape 6 inches wide continuously printed and bright colored 18” above all direct buried services, underground conduits and duct-banks.
7. Acceptable Manufacturers:
   a) Brady Corporation
   b) Silver Fox
   c) Brothers

2.3 ADMINISTRATION

A. Administration of the documentation shall include test results of each Permanent Link.

B. The test result information for each link shall be recorded in the memory of the field-test instrument upon completion of the test.

C. The test result records saved within the field-test instrument shall be transferred into a Windows® - based database utility that allows for the maintenance, inspection and archiving of these test records.

D. Alien Crosstalk measurements shall be stored to a PC upon completion of the test.

PART 3 – EXECUTION

3.1 GENERAL

A. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to field-testing. Any testing performed on incomplete systems shall be redone on completion of the work.

3.2 BALANCED TWISTED PAIR CABLE TESTING

A. Field-test instruments shall have the latest software and firmware installed.

B. Permanent Link test results including the individual frequency measurements from the tester shall be recorded in the test instrument upon completion of each test for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.

C. Permanent Link testing shall be performed on each cabling segment (connector to connector). Sampling is not acceptable.

D. Alien Crosstalk testing shall be performed using a sampling plan. An acceptance quality level (AQL) of 0,4 %, normal inspection, general inspection level I as defined in ISO 2859-1 for populations of up to 500,000 links shall be used. The following table represents this sampling level.

Installation size (No. of total links)	Sample size (No. of links to test)
3 – 33	100%
34 – 3,200	33
3,201 – 35,000	126
35,001 – 150,000	201

150,001 – 500,000	315

Disturbed (Victim) links chosen for Alien Crosstalk testing shall be an equal combination of short, medium and long links.

E. Permanent Link adapters made from twisted pair Category 5e, 6, 6A, 7 or 7_A cords are not permitted as their performance degrades with use and can cause false Return Loss failures.

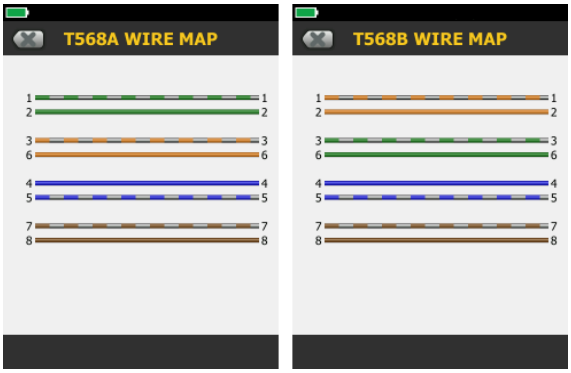
F. The installer shall build a reference link. All components shall be anchored so it is not possible to disturb them. The technician is to conduct a Category 6A Permanent Link test each day to ensure no degradation of the tester or its Permanent Link adapters.

G. Wire Map Measurement

1. The wire map test is intended to verify pin-to-pin termination at each end and check for installation connectivity errors. For each of the 8 conductors in the cabling, the wire map indicates:

   a) Continuity to the remote end
   b) Shorts between any two or more conductors
   c) Reversed pairs
   d) Split pairs
   e) Transposed pairs
   f) Distance to open on shield
   g) Any other miss-wiring

2. The correct connectivity of telecommunications outlets/connectors is defined in ANSI/TIA-568-C.2. Two color schemes are permitted. The user shall define which scheme is to be used. The field tester shall document which color scheme was used. Examples are given below:



H. Length Measurement

1. The length of each balanced twisted pair shall be recorded.
2. Since physical length is determined from electrical length, the physical length of the link calculated using the pair with the shortest electrical delay shall be reported and used for making the pass or fail determination.
3. The pass or fail criteria is based on the maximum length allowed for the Permanent Link as specified in ANSI/TIA-568-C.2 plus the nominal velocity of propagation (NVP) uncertainty of 10%. For a Permanent Link, the length measurement can be 325 ft. (99 m) before a fail is reported.

I. Propagation Delay measurement

1. Is the time it takes for a signal to reach the end of the link.
2. The measurement shall be made at 10 MHz per ANSI/TIA-1152.
3. The propagation delay of each balanced twisted pair shall be recorded.
4. Is not to exceed 498 ns per ANSI/TIA-568-C.2 Section 6.3.18.

J. Delay Skew measurement

1. Is the difference in propagation delay @ 10 MHz between the shortest delay and the delays of the other wire pairs.
2. The delay skew of each balanced twisted pair shall be recorded.
3. Is not to exceed 44 ns per ANSI/TIA-568-C.2 Section 6.3.19.

K. DC Resistance

1. Often reported as Resistance, is the loop resistance of both conductors in the pair.
2. Is not specified in ANSI/TIA-1152, but shall be recorded for all four pairs.

L. DC Resistance Unbalance

1. Often reported as Resistance Unbalance, is the difference in resistance of the two wires within the pair.
2. Is not specified in ANSI/TIA-1152 for a Permanent Link, but shall be recorded for all four pairs.

M. Insertion Loss

1. Is the loss of signal strength over the cabling (in dB).
2. The frequency resolution shall be:

   a) 1 – 31.25 MHz: 150 kHz
   b) 31.25 – 100 MHz: 250 kHz
   c) 100 – 250 MHz: 500 kHz
   d) 250 – 500 MHz: 1000 kHz

3. Worst case shall be reported for all four pairs in one direction only.
4. Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).
5. Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.7.

N. NEXT (Near-End Crosstalk)

1. Is the difference in amplitude (in dB) between a transmitted signal and the crosstalk received on other wire pairs at the same end of the cabling.
2. The frequency resolution shall be:

   a) 1 – 31.25 MHz: 150 kHz
   b) 31.25 – 100 MHz: 250 kHz
   c) 100 – 250 MHz: 500 kHz
   d) 250 – 500 MHz: 1000 kHz

3. Shall be measured in both directions. (12 pair to pair possible combinations)
4. Both worst case and worst margins shall be reported.

5. Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.8.
6. Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).
7. The Time Domain Xtalk data shall be stored for any marginal or failing NEXT results.

O. PS NEXT (Power Sum Near-End Crosstalk)

1. Is the difference (in dB) between the test signal and the crosstalk from the other pairs received at the same end of the cabling.
2. The frequency resolution shall be:

   a) 1 – 31.25 MHz: 150 kHz
   b) 31.25 – 100 MHz: 250 kHz
   c) 100 – 250 MHz: 500 kHz
   d) 250 – 500 MHz: 1000 kHz

3. Shall be measured in both directions. (8 pair possible combinations)
4. Both worst case and worst margins shall be reported.
5. Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.9.
6. Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).
7. The Time Domain Xtalk data shall be stored for any marginal or failing PS NEXT results.

P. ACR-N (Attenuation Crosstalk Ratio Near-End)

1. Is a calculation of NEXT minus Insertion Loss of the disturbed pair in dB.
2. The frequency resolution shall be:

   a) 1 – 31.25 MHz: 150 kHz
   b) 31.25 – 100 MHz: 250 kHz
   c) 100 – 250 MHz: 500 kHz
   d) 250 – 500 MHz: 1000 kHz

3. Shall be calculated in both directions.
4. Is not specified in ANSI/TIA-1152, but shall be recorded for all 12 possible combinations.

Q. PS ACR-N (Power Sum Attenuation Crosstalk Ratio Near-End)

1. Is a calculation of PS NEXT minus Insertion Loss of the disturbed pair in dB.
2. The frequency resolution shall be:

   a) 1 – 31.25 MHz: 150 kHz
   b) 31.25 – 100 MHz: 250 kHz
   c) 100 – 250 MHz: 500 kHz
   d) 250 – 500 MHz: 1000 kHz

3. Shall be calculated in both directions.
4. Is not specified in ANSI/TIA-1152, but shall be recorded for all 8 possible combinations.

R. ACR-F (Attenuation Crosstalk Ratio Far-End)

1. Is a calculation of FEXT minus Insertion Loss of the disturbed pair in dB.
2. The frequency resolution shall be:

   a) 1 – 31.25 MHz: 150 kHz

b) 31.25 – 100 MHz: 250 kHz
c) 100 – 250 MHz: 500 kHz
d) 250 – 500 MHz: 1000 kHz

3. Shall be measured in both directions. (24 pair to pair possible combinations)
4. Both worst case and worst margins shall be reported.
5. Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.11.
6. Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).

S. PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End)

1. Is a calculation of PS FEXT minus Insertion Loss of the disturbed pair in dB.
2. The frequency resolution shall be:

a) 1 – 31.25 MHz: 150 kHz
b) 31.25 – 100 MHz: 250 kHz
c) 100 – 250 MHz: 500 kHz
d) 250 – 500 MHz: 1000 kHz

3. Shall be measured in both directions. (8 pair possible combinations)
4. Both worst case and worst margins shall be reported.
5. Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.13.
6. Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).

T. Return Loss

1. Is the difference (in dB) between the power of a transmitted signal and the power of the signals reflected back.
2. The frequency resolution shall be:

a) 1 – 31.25 MHz: 150 kHz
b) 31.25 – 100 MHz: 250 kHz
c) 100 – 250 MHz: 500 kHz
d) 250 – 500 MHz: 1000 kHz

3. Shall be measured in both directions. (8 pair possible combinations)
4. Both worst case and worst margins shall be reported.
5. Shall be ignored at all frequencies where the Insertion Loss is less than 3 dB for that pair.
6. Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.6.
7. Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).
8. The Time Domain Reflectometer data shall be stored for any marginal or failing Return Loss results.

U. TCL (Transverse Conversion Loss)

1. Is the ratio (in dB) between a differential mode signal inject at the near-end and the common-mode signal measured at the near-end on the same wire pair.
2. The frequency resolution shall be:

a) 1 – 31.25 MHz: 150 kHz
b) 31.25 – 100 MHz: 250 kHz
c) 100 – 250 MHz: 500 kHz
d) 250 – 500 MHz: 1000 kHz

3. Shall be measured in both directions.
4. Is not specified in ANSI/TIA-1152 for a Permanent Link, but shall be recorded for all 8 possible combinations.

V. ELTCTL (Equal Level Transverse Conversion Transfer Loss)

1. Is the ratio (in dB) between a differential mode signal inject at the near-end and the common-mode signal measured at the far end on the same wire pair minus the Insertion Loss of that pair.
2. The frequency resolution shall be:

a) 1 – 31.25 MHz: 150 kHz
b) 31.25 – 100 MHz: 250 kHz
c) 100 – 250 MHz: 500 kHz
d) 250 – 500 MHz: 1000 kHz

3. Shall be measured in both directions.
4. Is not specified in ANSI/TIA-1152 for a Permanent Link, but shall be recorded for all 8 possible combinations.

W. PS ANEXT (Power Sum Alien Near-End Crosstalk)

1. Takes into account the combined alien crosstalk (statistical) on a receive pair from all external near-end disturbers operating simultaneously.
2. The frequency resolution shall be:

a) 1 – 31.25 MHz: 150 kHz
b) 31.25 – 100 MHz: 250 kHz
c) 100 – 250 MHz: 500 kHz
d) 250 – 500 MHz: 1000 kHz

3. The disturbed (victim) link shall have links to the left and right of it and if present, links above and below it.
4. Disturber cables shall include all links within the same bundle as the disturbed (victim) link and adjacent links
5. Should be measured in both directions if the link is patch panel to patch panel. If the link is patch panel to telecommunications outlet, then it shall be measured from the patch panel end only.
6. Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.21.

X. Average PS ANEXT (Power Sum Alien Near-End Crosstalk)

1. Is calculated by averaging the individual PSANEXT loss values, in dB, for all four pairs in the disturbed (victim) link.
2. The frequency resolution shall be:

a) 1 – 31.25 MHz: 150 kHz
b) 31.25 – 100 MHz: 250 kHz
c) 100 – 250 MHz: 500 kHz
d) 250 – 500 MHz: 1000 kHz

3. Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.22.

Y. PS AACR-F (Power Sum Alien Attenuation to Crosstalk Ratio Far-End)

1. AFEXT loss is the coupling of crosstalk at the far-end from external link pairs into a disturbed (victim) pair of the 4-pair link under test. PS AACR-F is the calculated power sum from all external pairs into the disturbed (victim) pair.
2. The frequency resolution shall be:

   a) 1 – 31.25 MHz: 150 kHz
   b) 31.25 – 100 MHz: 250 kHz
   c) 100 – 250 MHz: 500 kHz
   d) 250 – 500 MHz: 1000 kHz

3. The disturbed (victim) link shall have links to the left and right of it and if present, links above and below it.
4. Disturber cables shall include all links within the same bundle as the disturbed (victim) link and adjacent links
5. Should be measured in both directions if the link is patch panel to patch panel. If the link is patch panel to telecommunications outlet, then it shall be measured from the patch panel end only.
6. Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.25.

Z. Average PS AACR-F (Power Sum Alien Attenuation to Crosstalk Ratio Far-End)

1. Is calculated by averaging the individual PS AACR-F values, in dB, for all four pairs in the disturbed (victim) link.
2. The frequency resolution shall be:

   a) 1 – 31.25 MHz: 150 kHz
   b) 31.25 – 100 MHz: 250 kHz
   c) 100 – 250 MHz: 500 kHz
   d) 250 – 500 MHz: 1000 kHz

3. The disturbed (victim) link shall have links to the left and right of it and if present, links above and below it.
4. Disturber cables shall include all links within the same bundle as the disturbed (victim) link and adjacent links
5. Should be measured in both directions if the link is patch panel to patch panel. If the link is patch panel to telecommunications outlet, then it shall be measured from the patch panel end only.
6. Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568-C.2 Section 6.3.26.

3.3 ADMINISTRATION

A. Test results documentation

1. Test results saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of the test records. These test records shall be uploaded to the PC unaltered, i.e., “as saved in the field-test instrument”. The file format, CSV (comma separated value), does not provide adequate protection of these records and shall not be used.

2. The test results documentation shall be available for inspection by the Owner or the Owner's representative during the installation period and shall be passed to the Owner's representative within 5 working days of completion of tests on cabling served by a telecommunications room or of backbone cabling. The installer shall retain a copy to aid preparation of as-built information.
3. The database for the complete project, including twisted-pair copper cabling links, if applicable, shall be stored and delivered on CD or DVD prior to Owner acceptance of the building. This CD or DVD shall include the software tools required to view, inspect, and print any selection of the test reports.
4. Circuit IDs reported by the test instrument should match the specified label ID (see **Error! Reference source not found.** of this Section).
5. For Permanent Link testing, the detailed test results documentation data is to be provided in an electronic database for each tested balance twisted-pair and shall contain the following information

   a) The overall Pass/Fail evaluation of the link-under-test
   b) The date and time the test results were saved in the memory of the tester
   c) The identification of the customer site as specified by the end-user
   d) The name of the test limit selected to execute the stored test results
   e) The name of the personnel performing the test
   f) The version of the test software and the version of the test limit database held within the test instrument
   g) The manufacturer, model and serial number of the field-test instrument
   h) The adapters used
   i) The factory calibration date
   j) Wire Map
   k) Propagation Delay values, for all four pairs
   l) Delay Skew values, for all four pairs
   m) DC Resistance values, for all four pairs
   n) DC Resistance Unbalance, values for all four pairs
   o) Insertion Loss, worst case values for all four pairs
   p) NEXT, worst case margin and worst case values, both directions
   q) PS NEXT, worst case margin and worst case values, both directions
   r) ACR-F, worst case margin and worst case values, both directions
   s) PS ACR-F, worst case margin and worst case values, both directions
   t) Return Loss, worst case margin and worst case values, both directions
   u) TCL, worst case values both directions
   v) ELTCTL, worst case values, both directions.
   w) Time Domain Crosstalk data if the link is marginal or fails
   x) Time Domain Reflectometer data if the link is marginal or fails

6. For Alien Crosstalk testing, the detailed test results documentation data is to be provided in an electronic database for each tested balance twisted-pair and shall contain the following information

   a) The overall Pass/Fail evaluation of the link-under-test
   b) The date and time the measurements were made
   c) The identification of the customer site as specified by the end-user
   d) The name of the test limit selected to execute the stored test results
   e) The name of the personnel performing the test
   f) The version of the test software
   g) PS ANEXT, worst case margin for all four pairs

h) Average PS ANEXT, worst case margin
i) PS AACR-F, worst case margin for all four pairs
j) Average PS AACR-F, worst case margin

B. Record copy and as-built drawings

1. Provide record copy drawings periodically through out the project as requested by the Construction Manager or Owner, and at end of the project on a CD or DVD. Record copy drawings at the end of the project shall be in CAD format and include notations reflecting the as built conditions of any additions to or variation from the drawings provided such as, but not limited to cable paths and termination point. The as-built drawings shall include, but are not limited to block diagrams, frame and cable labeling, cable termination points, equipment room layouts and frame installation details. The as-builts shall include all field changes made up to construction completion:

   a) Field directed changes to pull schedule.
   b) Horizontal cable routing changes.
   c) Associated detail drawings.

END OF SECTION