

MCNARY DINING RESTROOM REDESIGN

ITB# 2022-007813

Exhibit G Specifications



Oregon State
University

Construction Contracts Administration
Oregon State University
644 SW 13th Ave.
Corvallis, Oregon 97333

Oregon State University
University Housing & Dining Services



**McNary Hall
Improvements**

Project Manual
Specifications
December 21, 2021

Permit - Bid Set

waterleaf

architecture, interiors & planning

www.waterleafarch.com



project no. 1113.03

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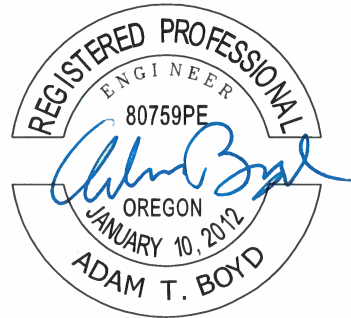
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SEALS PAGE



EXP. 12-31-23

I HEREBY CERTIFY THAT THIS PROJECT SPECIFICATION WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED ARCHITECT UNDER THE LAWS OF THE STATE OF OREGON

DIVISION 01 - GENERAL REQUIREMENTS

DIVISION 02 - EXISTING CONDITIONS

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THE MECHANICAL ENGINEER'S SEAL AND SIGNATURE AFFIXED HEREON INDICATES THIS ENGINEER'S REVIEW AND PARTICIPATION IN THE PREPARATION OF THE PROJECT MANUAL. PARTICIPATION IS LIMITED TO FOLLOW SPECIFICATION SECTIONS:

DIVISION 22 - PLUMBING

DIVISION 23 - HEATING AND AIR CONDITIONING

THE ELECTRICAL ENGINEER'S SEAL AND SIGNATURE AFFIXED HEREON INDICATES THIS ENGINEER'S REVIEW AND PARTICIPATION IN THE PREPARATION OF THE PROJECT MANUAL. PARTICIPATION IS LIMITED TO FOLLOW SPECIFICATION SECTIONS:

DIVISION 26 - ELECTRICAL

END OF SECTION

SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY OF WORK

- A. The Work Contract consists of interior improvements to existing rooms 115, 119, 120A, 122, 161, 162 and 163 of the McNary Dining Center on the Oregon State University Campus, Corvallis, Oregon. Improvements to include architectural, HVAC, plumbing, electrical, fire protection and IT in support of the remodel of restrooms to accommodate ADA and provide a better overall experience, replacing the dish machine (including replacing dish room floor tile, creating floor penetrations for fumigation and renewal of dish room finishes) and refreshing the Service Center desk area. The building shall remain occupied and in use during the course of construction.
- B. Work shall be started shall begin no sooner than June 13, 2022 an in no case prior to the signing of Contract on behalf of Oregon State University. The Contract may not be signed prior to approval of the Contractor's Certificate of Insurance by Construction Contract Administration (CCA), Oregon State University. Work shall be completed no later than September 12, 2022 with Substantial Completion is expected to be no later than August 12, 2022.

1.02 CONTRACTORS USE OF PREMISES

- A. Contractor shall limit use of the Premises for work and storage to allow for:
 - 1. Owner occupancy, day and night.
 - 2. Public use, day and night.
 - 3. Security.
 - 4. Safe entry and exit for vehicles and pedestrians.
 - 5. Fire egress.
- B. Coordinate all operations with the Owner's Authorized Representative during the construction period. A 96-hour notification is required prior to scheduled utility shutdowns or street closures, but more lead time is often required to schedule around other critical activities.
- C. Limit Contractor's employee parking to locations designated at the Pre-construction Conference.

1.03 OWNER OCCUPANCY

- A. The Owner will occupy the Premises during the entire period of construction for the conduct of normal operations. Cooperate with Owner's Authorized Representative in construction operations to minimize conflict and to facilitate the Owner's usage especially in the following areas:
 - 1. Restricted access and parking.

2. Use of stairs.
 3. Storage space availability.
- B. Conduct operations in such a way to ensure the least inconvenience to the general public, including:
1. Limitations and easements.
 2. Emergency vehicle access.
 3. Building access to the public, day and night.

1.04 ASBESTOS AND OTHER HAZARDOUS MATERIAL

- A. The Owner has made a reasonable attempt to locate and identify asbestos or other hazardous material that may be encountered during the course of the Work.
- B. If the Contractor observes or suspects the existence of asbestos, polychlorinated biphenyl (PCB) or other hazardous materials in the structure or components of the building, the Contractor shall immediately stop work and notify the Owner's Authorized Representative.
- C. The Owner will arrange for the removal of asbestos, polychlorinated biphenyl (PCB) or other hazardous materials as required by Facilities Services personnel or by separate contract.
- D. Schedule ten (10) days of slack or "down" time for the removal of hazardous materials without penalty to Owner for the delay of the Contract.

1.05 LEAD BASED PAINT

- A. The Owner may have tested existing paint in the project area and if levels are found the following conditions apply.
- B. Contractor shall remove paint as specified for surface preparation and capture removed material for disposal.
- C. Contractor shall follow OSHA guidelines involving exposure to workers.
- D. Owner will provide containers for Contractor's use at project site.
- E. Contractor shall comply with the requirements of DEQ and EPA and shall submit a lead abatement plan.
- F. Contractor shall separate lead contaminated material from effluent and water.
- G. Owner will dispose of lead paint and effluent resulting from stripping operation.
- H. Soil contaminated by stripping operations shall be replaced with topsoil.

END OF SECTION

SECTION 01 24 76

APPLICATIONS FOR PAYMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Work of this Section includes forms and procedures for progress payments.
- B. Related work specified elsewhere.
 - 1. For the primary discussion of payments, refer to OSU General Conditions, Section E, as supplemented.
 - 2. In compliance with OSU General Conditions, Section K, no payments beyond 75% will be made by the Owner before draft Operation and Maintenance Manuals have been received for review by the Owner.

1.02 APPLICATION FORMS

- A. For applications for payment, use sample Contract Payment Request (see below), contract payment request on company letterhead, or AIA Document G702, supported by AIA Document G703, Continuation Sheet, or similar document.
- B. Prepare the Schedule of Values in such a manner that each major item of Work and each subcontracted item of Work is shown as a line item broken down in terms of material and labor costs on AIA Document G703, Application Certification of Payment, Continuation Sheet or similar format. The sample continuation sheet shall be the minimum Schedule of Values breakdown.
- C. The Schedule of Values shall be submitted for review by the Owner prior to the first application for payment; and may be used when, and only when, accepted in writing by the Owner.
- D. Payment request is to include the Contractor's Federal Tax Identification number and return address.

1.03 PAYMENTS

- A. The Owner will make progress payments on account of the Contract once monthly for the scheduled duration of the project (i.e. three (3) payments on a three-month project), based on the value of work accomplished or materials on the job site, as stated in the Schedule of Values on the Application and Certificate Payment.
- B. Complete and forward Application to the Owner on or about the 15th day of each month for work performed the previous month and include certified payroll statements as specified in the OSU General Conditions.
- C. Submit one (1) copy of forms requesting payment to the Owner.
- D. Payments will be made on protected materials on hand at the job site properly stored,

protected, and insured.

- E. Estimated quantities shall be subject to the Owner's review and judgment.

1.04 EARLY PURCHASE AND PAYMENT OF MATERIALS AND EQUIPMENT

- A. Order materials and equipment requiring a long lead or waiting time early so as not to delay progress of the Work.
- B. The Contractor will be reimbursed for early order materials or equipment upon receipt and verification of quality and quantity against submittals and shipping documents by the Owner's Authorized Representative.
- C. Receipt shall be to the job site or stored at Owner's other premises in an orderly and safe manner, secured from normal weather damage.
- D. Security remains the responsibility of the Contractor.

END OF SECTION

CONTRACT PAYMENT REQUEST

DATE: _____

TO: University Financial Services
Oregon State University
850 SW 35th St.
Corvallis, OR 97333
FacServContracts@oregonstate.edu

Payment Request No. _____ Contract No. _____ Period from _____ to _____

Project: _____

Original Contract Amount \$ _____

Change Orders (Net Amount)..... \$ _____

Contract Total to Date \$ _____

=====

Total Completed and Stored to Date \$ _____

Less Retainage (5%), if applicable \$ _____

Total Earned, Less Retainage (if applicable)..... \$ _____

Less Previous Payments..... \$ _____

Net Amount Due this Request..... \$ _____

The undersigned Contractor certifies that, to the best of his/her knowledge, information, and belief, the Work covered by this request has been completed in accordance with the Contract Documents, that all amounts have been paid for Work for which previous applications for Payment were issued and payments received from the Owner, and that the amount shown herein is now due.

Contractor: _____

By: _____ **Date:** _____

Federal Tax ID Number: _____

Address: _____

SECTION 01 25 00

PRODUCT SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General requirements for the Work in relation to substitutions and product options.
- B. Submit to the Owner's property insurance carrier shop drawings, samples, and product data (such as manufacturer's standard schematic drawings and other literature) when required by individual Specifications sections.
- C. Related Work Specified Elsewhere
 - 1. Invitation to Bid.
 - 2. OSU General Conditions.

1.02 REQUESTS FOR SUBSTITUTIONS

- A. Requests for substitution of products in place of those specified shall be in accordance with Invitation to Bid, and as specified herein.

1.03 CONTRACTOR'S RESPONSIBILITIES

- A. Investigate proposed products and determine that they are equal or superior in all respects to products specified.
- B. Provide same guarantee for accepted substitutions as for products specified.
- C. Coordinate installation of accepted substitutions into the Work, making such changes as may be required for the Work to be complete in all respects.

1.04 SUBSTITUTIONS DURING BIDDING

- A. Submit one electronic copy of the following information with each request to the Owner:
 - 1. Substitution request form provided below.
 - 2. Comparison of proposed substitution with product, material or system specified.
 - 3. Complete data, substantiating compliance of proposed substitution with the Contract Documents.
 - 4. Test numbers and supporting reports, indicating compliance with referenced standards.
 - 5. Evidence that warranty requirements are acceptable.
 - 6. Details indicating specific deviations proposed for the substitution.
 - 7. Reference and applicable Specification sections.
 - 8. Applicable product samples.
- B. All substitution requests shall be received in the Owner's office prior to the deadline for questions as identified in the Invitation to Bid. Requests received after this date

will not be considered.

1.05 SUBSTITUTIONS DURING CONSTRUCTION

- A. Substitutions will normally not be considered after date of Contract except when required due to unforeseen circumstances.
- B. Within a period of thirty (30) days after date of Contract, the Owner may, at its option, consider formal written requests for substitution of products in place of those specified, when submitted in accordance with the requirements stipulated herein.
- C. One or more of the following conditions must be documented in any such request:
 - 1. Required for compliance with final interpretation of code or insurance requirements.
 - 2. Required due to unavailability of a specified product.
 - 3. Required because of the inability of the specified product to perform properly or to fit in the designated space.
 - 4. Substitution would be substantially in the best interest of the Owner in terms of cost, time, or other considerations.

1.06 SUBSTITUTIONS NOT PERMITTED

- A. If implied on submittals without first requesting approval thereof.
- B. If acceptance will require substantial revision of the Contract Documents.

END OF SECTION

SUBSTITUTION REQUEST FORM

TO: _____

PROJECT: _____

SPECIFIED ITEM:

Section	Page	Paragraph	Description
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The undersigned requests consideration of the following:

PROPOSED SUBSTITUTION: _____

Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

Attached data also includes description of changes to Contract Documents which proposed substitution will require for its proper installation.

The undersigned states that the following paragraphs, unless modified on attachments, are correct:

1. The proposed substitution does not affect dimensions shown on Drawings.
2. The undersigned will pay for changes to the building design, including engineering design, detailing and construction costs caused by the requested substitution.
3. The proposed substitution will have no adverse effect on other trades, the construction schedule, or specified warranty requirements.
4. Maintenance and service parts will be locally available for the proposed substitution.

The undersigned further states that the function, appearance and quality of the Proposed Substitution are equivalent or superior to the Specified Item.

Submitted by:

Signature _____

Firm _____

Address _____

Date _____

Telephone _____

For use by Design Consultant:

Accepted Accepted as noted

Not Accepted Received too late

By _____

Date _____

Remarks _____

Attachments:

SECTION 01 31 19

PROJECT MEETINGS

PART 1 GENERAL

1.01 PRE-CONSTRUCTION MEETING

- A. Architect/Engineer/Designer, Contractor and Owner will meet prior to start of the Work (within seven (7) days after notice to proceed) to discuss at least the following topics and any others of mutual interest.
1. Schedule of Values
 2. Permit Status/tree protection/erosion control
 3. List of sub-contractors
 4. Job inspections.
 5. Early purchase of, and/or lead time requirements for material and equipment/repurchase of equipment
 6. Monthly payment date/SOP for pay requests
 7. Portion of site to be occupied by construction.
 8. Parking/Staging areas
 9. Non-smoking campus requirements
 10. Maintenance of access and safety.
 11. Processing of field decisions and change orders
 12. Labor provisions/labor rates for subs
 13. Material submittals/deferred submittals
 14. Owner access during construction.
 15. Review of Contract Documents/review ADA requirements/cross-slopes
 16. Coordination procedures and separate contracts.
 17. Progress schedules.
 18. Critical Work sequencing.
 19. Safety and emergency procedures/24 hour contact numbers
 20. Security procedures.
 21. Hazardous materials.
 22. Progress meetings.
 23. Contract close-out.
- B. Location of Meeting: Project site

1.02 PROGRESS MEETINGS

- A. The Contractor will schedule and administer progress meetings and will:
1. Prepare agendas.
 2. Schedule progress meetings, frequency, time and day to be determined during pre-construction meeting.
 3. Make physical arrangements for and preside at meetings.
 4. Record minutes and include decisions.

5. Distribute copies of minutes to participants within four (4) days after meetings.
- B. Location of Meetings: Project site.
- C. Attendance:
1. The Owner or Owner's Authorized Representative.
 2. Contractor.
 3. Subcontractors affected by agenda.
 4. Project Architect/Engineer/as necessary.
 5. Owner will attend meeting to ascertain Work is expedited consistent with progress schedule and with Contract Documents.
- D. Minimum Agenda:
1. Review and approve minutes from previous meeting.
 2. Review Work progress since previous meeting.
 3. Discuss field observations, and problems.
 4. Review delivery schedules, construction schedule, and identify problems which impede planned progress.
 5. Review proposed changes.
 6. Material submittals.
 7. Note all new subcontractors performing Work at the job site.

END OF SECTION

SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, SAMPLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submit to the Owner shop drawings, samples, and product data (such as manufacturer's standard schematic drawings and other literature) when required by individual Specifications sections.
- B. Related Work Specified Elsewhere
 - 1. OSU General Conditions.

1.02 SUBMITTAL SCHEDULING

- A. For items requiring review by the Owner only, submittals shall be sent to the Owner at least 15 calendar days before the date each is required for fabrication or installation.
- B. Submittals to be reviewed by Owner's consultants shall be sent to the Owner at least 20 calendar days before the date each is required for fabrication or installation.
- C. Submittals to be reviewed by Owner's property insurance carrier shall be sent to Owner as directed in individual specification sections.
- D. Submittals involving Substitution requests or other modifications requiring review by the Owner and/or the Owner's consultants shall be sent to the Owner at least 20 calendar days before the date each is required for fabrication or installation.

1.03 SUBMITTAL CONTENT AND FORMAT

- A. General Requirements:
 - 1. Shop Drawings: Submit in electronic format and, if requested by Owner's Authorized Representative, submit one reproducible transparency and 1 print of each drawing.
 - 2. Product Data: Submit electronically, and if requested by Owner's Authorized Representative, up to 6 hard copies.
 - 3. Samples: Submit the number and type stated in each Specification Section. Submit a minimum of three sets of color samples where color selection is required.
 - 4. Submittals shall include:
 - a. Date and revision dates return date requested.
 - b. Project title and number.
 - c. The names of the Contractor, subcontractor, supplier, and manufacturer.
 - d. Identification of product or material, with Specification Section number.
 - e. Relation to adjacent critical features of work or materials.
 - f. Field dimensions, clearly identified as such.
 - g. Applicable standards, such as ASTM number or Federal Specification.

- h. Identification of deviations from Contract Documents, and for products accompanied by Substitution request as required by Section 01 25 00.
 - i. Contractor's stamp legibly signed, essentially as follows:
 - 1) The undersigned, acting on behalf of the Contractor, certifies that this submittal has been reviewed and is approved; products have been verified as being as specified, field measurements and field construction criteria have been or will be coordinated, and the submittal is in compliance with Contract Documents.
5. Re-submission Requirements:
- a. Revise initial drawings as required and resubmit as specified for initial submittal.
 - b. Indicate on drawings any changes which have been made other than those requested by the Owner or the owner's consultants.
6. The Owner may return without review any submittal not meeting the requirements listed above.
- B. Shop Drawings:
- 1. Present data in a clear and thorough manner.
 - 2. Details shall be identified by reference to sheet and detail, schedule or room numbers shown on Contract Documents.
 - 3. Structural items shall be identified by location in the completed structure. Identify details by reference to contract sheet and detail numbers.
 - 4. Minimum sheet Size: 8 ½ x 11".
- C. Product Data:
- 1. Manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations and other standard descriptive data:
 - a. Clearly mark each copy to identify pertinent product or models.
 - b. Show dimensions, weights, and clearances required.
 - c. Show performance data consisting of capabilities, ROM, KW, pressure drops, design characteristics and consumption; conforming as closely as possible to the test methods referenced in the Plans and Specifications.
 - d. Show wiring or piping diagrams and controls.
 - 2. Manufacturer's standard schematic drawings and diagrams:
 - a. Modify to delete information which is not applicable.
 - b. Supplement standard information to provide information specifically applicable to the Work.
- D. Samples:
- 1. Insure that samples are of sufficient size to indicate the general visual effect or color.
 - 2. Where samples must show a range of color, texture, finish, graining, or other property, submit sets of pairs illustrating the full scope of this range.
 - 3. One (1) sample or one (1) set of approved samples will be retained by the Owner;

final work will be measured against approved samples.

1.04 QUALITY ASSURANCE

- A. Process submittals in ample time for review, as applicable, so as to not delay the Work. All submittals shall be received by the Owner within ten (10) days after pre-construction.

1.05 DEFINITIONS

- A. The Owner will mark reviewed materials as follows:
 - 1. "No Exception Taken," which means fabrication, manufacture and/or installation may proceed.
 - 2. "Make Revisions Noted," which means fabrication, manufacture and/or installation may proceed with revisions as noted.
 - 3. "Revise and Resubmit," which means that fabrication, manufacture and/or installation may not proceed.
 - 4. "Rejected," which means do not proceed; make arrangements for the review of the proposed Work with the Owner as soon as possible.

1.06 PROCESSING

- A. Review submittals, make necessary corrections, and become familiar with the content of the submittals.
- B. Mark each item with Contractor's stamp.
- C. Accompany submittals with a transmittal letter bearing the project name, Contractor's name, number of items, and other pertinent data.
- D. Keep one copy of each reviewed submittal on the job site at all times.
- E. Be responsible for obtaining and distributing prints of shop drawings to the various suppliers, and the Owner once review process has been completed. Make prints of reviewed shop drawings only from transparencies which carry the appropriate stamp and endorsement.

END OF SECTION

SECTION 01 42 13

ABBREVIATIONS AND SYMBOLS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

- A. Words which may be found elsewhere in the Project Manual and Drawings are abbreviated in accordance with the standards set forth in the following table:

A/C	air conditioning	CEM	cement
AB	anchor bolt	CF	cubic foot
AC	asphaltic concrete	CFOI	contractor furnished owner installed
ACT	acoustical tile	CG	corner guard
AD	area drain	CH	ceiling height
ADD	addendum	CI	cast iron
ADD'L	additional	CJ	control joint
ADH	adhesive	CKBD	chalkboard
AFF	above finish floor	CL	centerline
AGG	aggregate	CLG	ceiling
AL	aluminum	CLR	clear(ance)
ALLOW	allowable	CM	construction manager
ALT	alternate	CMT	ceramic mosaic (tile)
ANOD	anodized	CMU	concrete masonry unit
AP	access panel	COL	column
APPRX	approximate	COM	communications
ARCH	architect(ural)	CONC	concrete
ASPH	asphalt	CONN	connect(ion)
AUTO	automatic	CONST	construction
AVE	avenue	CONT	continuous or continue
BD	board	CONTR	contract(or)
BIT	bituminous	CPT	carpet
BLDG	building	CRS	course(s)
BLKG	blocking	CS	countersink
BM	bench mark, beam(s)	CSMT	casement
BOT	bottom	CT	ceramic tile
BRZ	bronze	CTR	center
BS	both side	CVG	clear vertical grain
CB	catch basin	CW	cold water
		CWT	ceramic wall tile
		CY	cubic yard

D	depth	FA	fire alarm
DEMO	demolish, demolition	FAF	fluid applied flooring
DEP	depressed	FARF	fluid applied resilient floor
DF	drinking fountain	FAS	fasten, fastener
DIA	diameter	FBD	fiberboard
DIAG	diagonal	FBT	finished blowing temperature
DIM	dimension	FD	floor drain, fire damper
DISP	dispenser	FE	fire extinguisher
DIV	division	FEC	fire extinguisher cabinet
DL	dead load	FF	factory finish
DMT	demountable	FGL	fiberglass
DN	down	FHMS	flathead machine screw
DP	dampproofing	FHWS	flathead wood screw
DR	door	FIN	finish(ed)
DS	downspout	FLCO	floor cleanout
DT	drain tile	FLR	floor(ing)
DTL	detail	FLUR	fluorescent
DW	dumbwaiter	FND	foundation
DWG	drawing(s)	FOC	face of concrete
DWR	drawer	FOIC	furnished by owner/installed by contractor
EA	each	FOIO	furnished by owner/installed by owner
EB	expansion bolt	FOM	face of masonry
EF	each face	FP	fireproofing, flash point
EJ	expansion joint	FPHB	freeze-proof hose bib
EL	elevation	FR	fire resistive, fire rated
ELEC	electric(al)	FRM	frame(d), (ing)
EMBED	embedment	FS	full size
EMER	emergency	FSS	finished structural slab
ENCL	enclose(ure)	FT	foot
EP	electrical panel board	FTG	footing
EQ	equal	FTS	finished topping slab
EQUIP	equipment	GA	gage, gauge
EST	estimate	GALV	galvanized
EVT	equiviscous temperature	GB	grab bar or gypsum board
EW	each way	GC	general contractor
EWC	electric water cooler	GI	galvanized iron
EX.EXIT	existing	GL	glass, glazing
EXH	exhaust	GLS	glass resin wall surfacing
EXP	exposed		
EXT	exterior		

GP	gypsum	LL	live load
		LONGIT	longitudinal
HB	hose bib	LP	low point
HBD	hardboard	LW	lightweight
HC	hollow core		
HD	heavy duty	MAX	maximum
HDR	header	MB	machine bolt
HDW	hardware	M. MECH	mechanic(al)
HM	hollow metal	MFR	manufacture(r)
HOR	horizontal	MH	manhole
HP	high point	Min	minimum, minute
HR	hour	MISC	miscellaneous
HT	height	MO	masonry opening
HTG	heating	MO#	model number
HVAC	heating, ventilating, air conditioning	MOD	modular
HWD	hardwood	MPH	miles per hour
HWH	hot water heater	MS	machine screw
		MTL	metal
ID	inside diameter, identification	MULL	mullion
IN	inch	MWP	membrane waterproofing
INCIN	incinerator		
INCL	include(d), ion)	NAT	natural, natural finish
INT	interior	NIC	not in contract
INV	invert	NO	number
		NOM	nominal
		NTS	not to scale
JB	junction box		
JC	janitor's closet	OA	overall
JT	joint	OBS	obscure
		OC	on center(s)
KD	kiln dried	OD	outside diameter
KCP	Keene's cement plaster	OF	overflow
KO	knockout	OFCI	owner furnished contractor installed
KP	kick plate	OFOI	owner furnished owner installed
		OHMS	ovalhead machine screw
LAB	laboratory	OHWS	ovalhead wood screw
		OPG	opening
LAM	laminated)	OPP	opposite
LAV	lavatory	OZ	ounce(s)
LBS	pounds		
		P	paint(ed)
LH	left hand		

PB	push button	SIM	similar
PCF	pounds per cubic foot	SL	sleeve
PCP	putting coat plaster	SOG	slab on grade
PERF	perforate(d)	SPEC	specification(s)
PL	plate, property line	SQ	square
PLAM	plastic laminate	SS	storm sewer
PLAS	plaster	S4S	finished 4 sides
PNL	panel	SD	storm drain
PP	push plate	ST	steel, street
PR	pair	ST ST	stainless steel
PREP	prepare	STD	standard
PSF	pounds per square foot	STR	structural
PSI	pounds per square inch	SUPP	supplement
PT	point, pressure treated	SUPT	support
PTN	partition	SUSP	suspended
PVC	polyvinyl chloride	SV	sheet vinyl
PWD	plywood		
		T	tread
QT	quarry tile	TBM	top bench mark
		T&G	tongue and groove
R	rise	TB	towel bar
RA	return air	TC	top of curb
RAD	radius	TEL	telephone
RCP	reflected ceiling plan	TEMP	tempered
RD	roof drain	THK	thickness
REF	reference	TKBD	tackboard
REFR	refrigerator	TO	top of
REINF	reinforce(ing)	TP	top of paving
REQ	required	TRANS	transverse
RET'G	retaining	TS	top of slab
REV	revision(s), revised	TV	television
RH	right had	TW	top of wall
RM	room	TYP	typical
RO	rough opening		
RSF	resilient sheet flooring	UNO	unless noted otherwise
		VAT	vinyl asbestos tile
SC	solid core	VB	vapor barrier
SCHED	schedule	VCT	Vinyl Composition Tile
SEC	section	VERT	vertical
SF	square feet (foot)	VG	vertical grain
SHT	sheet	VIF	verify in field
SHTHG	sheathing		

VWC	vinyl wall covering	WP	waterproof(ing)
W	width, wide, water	WNS	wainscot
W/	with	WR	water resistant
W/O	without	WS	waterstop
WC	water closet	WW	window wall
WD	wood, wood finish	WWC	wood wall covering
		WWF	woven wire fabric

B. Words which may be found elsewhere in the Project Manual and Drawings are abbreviated in accordance with the standards set forth in the following table:

&	and
λ	angle
@	at
ι	diameter, round
"	inches
:	is, shall b
'	feet
ζ	perpendicular
/	per
%	percent
#	pound, number
X	by (as in 2 by 4)

END OF SECTION

SECTION 01 42 16

DEFINITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Words which may be found elsewhere in the Contract Documents are defined in accordance with the standards set forth in the following table:

Approve:

Where used in conjunction with Architect's response to submittals, requests, applications, inquiries, reports and claims by Contractor, the meaning of term "approved" will be limited to the Architect's responsibilities and duties as specified in General and Supplementary Conditions. In no case will "approval" by Architect be interpreted as a release of Contract requirements.

As Detailed, As Shown:

Where "as detailed", "as shown" or words of similar importance are used, it shall be understood that reference to the Drawings accompanying the Specifications is made unless otherwise stated.

As Directed, As Required, As Authorized, As Reviewed, As Accepted:

Where "as directed", "as required", "as authorized", "as reviewed", "as accepted" or words of similar importance are used, it shall be understood that the direction, requirement, permission, authorization, review, or acceptance of the Architect is intended, unless otherwise stated.

As Indicated:

Where "as indicated" is used it shall be understood that reference to Drawings and/or Specifications is made unless otherwise stated.

Directed, Requested, etc.:

Terms such as "directed," "requested," "authorized," "selected," will be understood as "directed by Architect," "requested by Architect," and similar phrases shall not be interpreted to extend Architect's responsibility into Contractor's responsibility for construction supervision.

Furnish:

Except as otherwise defined in greater detail the term "furnish" is used to mean supply and deliver to project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

Indicated:

The term "indicated" is a cross-reference to graphic representations, notes or schedules on drawings, to other paragraphs or schedules in the specifications and to similar means of recording requirements in Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used in lieu of "indicated," it is for purpose of helping reader locate cross-reference and no limitation of location is intended except as specifically noted.

Install:

Except as otherwise defined in greater detail, the term "install" is used to describe operations at project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations, as applicable in each instance.

Installer:

The term "installer" is defined as the entity (person or firm) engaged by Contractor, or its subcontractor or sub-subcontractor for performance of a particular unit of Work at project site, including installation, erection, application and similar required operations. It is a general requirement that such entities (Installers) be expert in operations they are engaged to perform.

Provide:

Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.

END OF SECTION

SECTION 01 42 19

REFERENCE STANDARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Quality Assurance.
- B. Location of References.
- C. Schedule of References.

1.02 QUALITY ASSURANCE

- A. For products or quality of work specified by association, trade, or federal 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 date of issue current on date of Contract Documents.
- C. General Applicability of Standards: Except where Contract Documents include more stringent requirements, applicable standards of the construction industry have the same force and effect as if bound or copied directly into Contract Documents.
- D. Such standards are made a part of the Contract Documents by reference.
- E. Individual sections indicate which codes and standards the Contractor must keep at the project site, available for reference.
- F. Referenced industry standards take precedence over standards which are not referenced but recognized in industry as applicable.
- G. Non-referenced standards are not directly applicable to the Work, except as a general requirement of whether the Work complies with standards recognized in the construction industry.

1.03 LOCATION OF REFERENCES

- A. Valley Library, Oregon State University.

1.04 SCHEDULE OF REFERENCED ASSOCIATIONS

AIA American Institute of Architects

	WWW.AIA.ORG
AISC	American Institute of Steel Construction WWW.AISC.ORG
AISI	American Iron and Steel Institute WWW.STEEL.ORG
ANSI	American National Standards Institute WWW.ANSI.ORG
APA	American Plywood Association WWW.APAWOOD.ORG
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers WWW.ASHRAE.ORG
ASTM	American Society for Testing and Materials WWW.ASTM.ORG
AWPA	American Wood Protection Association WWW.AWPA.COM
AWS	American Welding Society WWW.AWS.ORG
BIA	Masonry Institute of America WWW.MASONRYINSTITUTE.ORG
BOLI	Oregon Bureau of Labor and Industries WWW.BOLI.STATE.OR.US
CCB	Construction Contractors Board WWW.OREGON.GOV.CCB/
CDA	Copper Development Association WWW.COPPER.ORG
CISPI	Cast Iron Soil Pipe Institute WWW.CISPI.ORG
CSI	Construction Specification Institute WWW.CSINET.ORG
DEQ	Department of Environmental Quality (Oregon) WWW.OREGON.GOV/DEQ/

DHI	Door and Hardware Institute WWW.DHI.ORG
DOT	Department of Transportation WWW.DOT.GOV
EPA	U.S. Environmental Protection Agency WWW.EPA.GOV
FM	Factory Mutual System WWW.FMGLOBAL.COM
FS	Federal Specification General Services Administration Specifications and Consumer Information Distribution Section (WFSIS) WWW.GSA.GOV/PORTAL/CONTENT/103856
IBC	International Building Code WWW.ICCSAFE.ORG
ICBO	International Conference of Building Officials PUBLICECODES.CITATION.COM/ICOD/IBG/INDEX.HTM
IRS	Internal Revenue Service WWW.IRS.GOV
ISA	Instrumentation Systems and Automation Society WWW.ISA.ORG
NAAMM	National Association of Architectural Metal Manufacturers WWW.NAAMM.ORG
NBFU	National Board of Fire Underwriters WWW.NFPA.ORG
NEC	National Electric Code WWW.NECPLUS.ORG
NEMA	National Electrical Manufacturers' Association WWW.NEMA.ORG
NESC	National Electrical Safety Code WWW.IEEE.ORG
NFPA	National Fire Protection Association WWW.NFPA.ORG

NRCA	National Roofing Contractors' Association WWW.NRCA.NET
OAR	Oregon Administrative Rules ARCWEB.SOS.STATE.OR.US/404.HTML
OESP	State of Oregon Electrical Specialty Code http://www.bcd.oregon.gov/programs/online_codes.html
ORS	Oregon Revised Statutes LANDRU.LEG.STATE.OR.US/ORS/
OSHA	Occupational Safety and Health Administration WWW.OSHA.GOV
OSSC	Oregon Structural Specialty Code http://www.bcd.oregon.gov/programs/online_codes.html
PS	Product Standard STANDARDS.GOV/STANDARDS.CFM
SDI	Steel Door Institute WWW.STEELDOOR.ORG
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association WWW.SMACNA.ORG
SPRI	Single Ply Roofing Institute WWW.SPRI.ORG
SSPC	Steel Structures Painting Council WWW.SSPC.ORG
SWRI	Sealing, Waterproofing and Restoration Institute WWW.SWIRONLINE.ORG
UBC	Uniform Building Code (See ICBO)
UFC	Uniform Fire Code WWW.NFPA.ORG
UL	Underwriters' Laboratories, Inc. WWW.UL.COM
UMC	Uniform Mechanical Code WWW.UBC.COM

UPC Uniform Plumbing Code
 WWW.UBC.COM

WHL Warnock Hersey Laboratories
 WWW.INTEK.COM/MARKS/WH/

WCLIB West Coast Lumber Inspection Bureau
 WWW.WCLIB.ORG

WWPA Western Wood Products Association
 WWW.WWPA.ORG

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Codes, regulations and permits.
- B. Procedures for quality control.

1.02 OWNER RESPONSIBILITIES

- A. Owner will employ and pay for services of an independent testing laboratory to perform inspection, sampling and testing as required by local building authority.
- B. Owner's Authorized Representative will provide on-site observation during construction.

1.03 CODES, REGULATIONS AND PERMITS

- A. All Work shall conform with the Oregon Structural Specialty Code (OSSC) based on the International Building Code (IBC), as amended by the State of Oregon Building Codes Division and the edition designated by the governing authority.
- B. Contractor shall comply with all applicable state and local construction codes.
- C. References to codes, Specifications and standards referred to in the Contract Documents shall mean, and are intended to be, the latest edition, amendment or revision of such reference standard in effect as of the date of these Contract Documents.
- D. The Owner shall be responsible for all permits and City of Corvallis plan review fees; the Contractor shall be responsible for all licenses and associated fees required for the Project.
- E. Contractor shall arrange and attend all required permit inspections and furnish evidence of approved City inspection reports per Section 01 77 00.

1.04 QUALITY OF WORK

- A. It is the true and specific intent of these Specifications that quality of Work on all phases of the construction and embracing all the trade sections shall be of high quality performed by workers skilled in their trade and performing their Work only according to the standard of best practice of the trade.
- B. All manufactured articles, materials, and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned in accordance with manufacturer's directions unless otherwise specified.
- C. If Work is required in a manner to make it impossible to produce first quality Work, or should discrepancies appear among Contract Documents, request interpretation from

Architect before proceeding with Work.

- D. Failure to secure interpretation may cause rejection by Architect or owner of installation.

1.05 LAYOUT

- A. Be responsible for properly laying out the Work and for lines and measurements for the Work.
- B. Verify the figures shown on the drawings before laying out the Work and report errors or inaccuracies to the Architect before commencing Work.
- C. Strict compliance with maximum slopes is required. Accessible parking spaces and adjacent access aisles with slope exceeding 2% in any direction, as determined by OSU, shall be removed and replaced by the contractor at their expense.
- D. Strict compliance with maximum slopes is required. New sidewalks exceeding 1:20 slope or with cross slope exceeding 2%, as determined by OSU, shall be removed and replaced by the contractor at their expense. Ramps exceeding 1:16 slope or with cross slope exceeding 2%, as determined by OSU, shall be removed and replaced by the contractor at their expense.

1.06 SUPERVISION

- A. The Contractor shall maintain effective supervision on the project at all times Work is being performed.
- B. The superintendent shall be the same person throughout the project and shall attend the preconstruction conference.

1.07 INSPECTIONS AND TESTING

- A. Contractor shall notify the Owner at least twenty-four (24) hours in advance of any required progress inspection or final inspection including final punch list inspection.
- B. Cooperate with laboratory personnel, provide access to Work and furnish incidental equipment material and labor required for field testing and sample taking.

1.08 EVALUATION OF TESTS AND INSPECTIONS

- A. Results of laboratory and/or field control tests and inspections shall be the principal basis upon which satisfactory completion of Work shall be judged.
- B. If results of tests and inspections indicate Work is below requirements of Contract Documents, that portion of Work is subject to rejection.

1.09 ADJUSTMENTS

- A. Remove and replace Work so rejected at Contractor's expense including costs of subsequent tests and inspections until Work meets requirements of Contract Documents.

- B. The Owner reserves the right to perform any testing as may be required to determine compliance with the Contract Documents.
- C. Costs for such testing will be the Owner's responsibility unless testing indicates noncompliance. Cost for such testing indicating noncompliance shall be borne by the Contractor.
- D. Noncomplying Work shall be corrected and testing will be repeated until the Work complies with the Contract Documents.
- E. Contractor will pay costs for retesting noncomplying Work.

END OF SECTION

SECTION 01 51 00

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

- A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction.
- B. Standards: Comply with NFPA Code 241, "Building Construction and Demolition Operations", ANSI-A10 Series standards for "Safety Requirements for Construction and Demolition".
- C. Electrical Service: Comply with NEMA, NEC and UL standards and regulations for temporary electric service; install service in compliance with National Electric Code (NFPA 70).
- D. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use; obtain required certifications and permits if required.

1.03 PROTECTION

- A. Protect sidewalks, asphalt paving, concrete, trees, shrubs, and lawn areas at all times from damage resulting from construction activities.
- B. Prevent materials from clogging catch basins and yard drains; leave drains clean and in proper working condition.
- C. Protect Existing Irrigation Systems:
 - 1. In the event damage occurs to an underground irrigation system as a direct result of a Contractor's activities, the Contractor shall repair/replace or be assessed a charge at the discretion of the Owner.
 - 2. If repairs are to be made by the Contractor, the repairs will be inspected by the Owner's Authorized Representative prior to backfilling.
 - 3. Any galvanized pipe that requires repair shall be repaired at a threaded coupling, not by use of a compression coupling.
- D. Protect Existing Air Handling Systems:
 - 1. Contractor shall be responsible for protection of the cleanliness of the existing air handling system at all times. This protection shall include:
 - a. During site work or building demolition, prefilters shall be provided and maintained on all building outside air intakes at all times throughout the construction duration.

- b. During any interior work that may create dust in the interior space and adjacent corridor/hallways, air filters shall be provided and maintained on all affected air return and exhaust grilles. Where air flow in or out of the space is not required, all air duct openings shall be temporarily blanked off with plywood or sheet metal.
 - c. Prior to starting any work, the Contractor shall record and submit to the Owner's Authorized Representative, pressure readings across all existing air handler air filter banks before installation of new prefilters.
 - d. Upon completion of all Work affecting existing air handling systems, the Contractor shall remove all temporary filters, covers and associated parts and restore the system to its original operating condition unless otherwise stated elsewhere in the Contract Documents
- E. Clean, repair, resurface, or restore existing surfaces to their original, or better, condition, or completely replace such surfaces to match existing, where damaged by construction operations.
- F. Security is the responsibility of the Contractor.
- G. Construction Debris:
- 1. Debris shall not be allowed to remain around the buildings during performance of Work, but shall be disposed of as rapidly as it accumulates.
 - 2. On completion of Work, the buildings and grounds shall be left in a condition that is equal to or better than original condition.
 - 3. In case of failure to do so, the Owner may remove rubbish and charge the cost to the Contractor.
- H. The Contractor shall manage a safe job environment for both the safety of all the people around the Work site as well as the safety of the Owner's and general public's property.
- I. The Contractor shall provide and maintain suitable barricades, shelters, lights, and danger signals during the progress of the Work; they shall meet the requirements of the local building code and OSHA.

1.04 DRAINAGE

- A. Verify that all rain drains in the construction areas are in working order and notify the Owner's Authorized Representative in writing of any rain drains that are plugged, prior to the start of the Work.
- B. Start of Work will be considered as acknowledgment that all drains are clear and in good working order.
- C. All drains shall be left in a clean and proper working condition.

1.05 CONSTRUCTION PROJECT SAFETY FORM

- A. Contractor shall submit to the Owner, prior to signing the Contract, the completed

"Construction Project Safety Form", which is provided with instructions at the end of this Section.

1.06 TEMPORARY UTILITIES

- A. Temporary Utilities:
 - 1. Prepare a schedule indicating dates for implementation and termination of each temporary utility.
 - 2. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of the permanent service.
- B. Conditions of Use:
 - 1. Keep temporary services and facilities clean and neat in appearance.
 - 2. Operate in a safe and efficient manner.
 - 3. Take necessary fire prevention measures.
 - 4. Do not overload facilities or permit them to interfere with progress.
 - 5. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.
- C. Electrical Service:
 - 1. Service limited to 20 amp 120V circuits will be paid for by the Owner.
 - 2. Connection to the service shall be the responsibility of the Contractor, with the Owner's approval.
 - 3. Coordinate with the Owner's Authorized Representative.
- D. Water Service:
 - 1. Service in reasonable quantities for the Project will be paid for by the Owner.
 - 2. Connection to the service shall be the responsibility of the Contractor, with the Owner's approval.
 - 3. Coordinate with the Owner's Authorized Representative.

1.07 TEMPORARY SUPPORT FACILITIES

- A. Temporary Sanitary Facilities:
 - 1. Provide and maintain an adequate number of facilities for the use of all persons employed on the Work during construction.
 - 2. Provide enclosed, weatherproof facilities with heat as required.
 - 3. Use of new or existing Owner's facilities will not be permitted.
- B. Temporary Heat and Ventilation:
 - 1. As necessary, provide temporary heat and ventilation required by construction activities, for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.

- C. Telephone Equipment: Provide telephone communications at project site.
- D. Existing Services:
 - 1. Do not interrupt any existing service.
 - 2. Prior request and approval of the Owner's Representative will enable the Owner to shut down any utility required by the Work.
 - 3. Contractor shall not shut down utilities.

1.08 TEMPORARY BARRIERS AND ENCLOSURES

- A. Provide barriers and fencing to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage.
- B. Provide Commercial grade chain link fence construction.
- C. Provide 6 foot high fence around construction site as directed by Owner's Authorized Representative; equip with vehicular and pedestrian gates with lock.
- D. Exterior Closures: Provide temporary secured, weather-tight closures at exterior openings, to permit acceptable working conditions and protection of the Work.
- E. Interior Closures:
 - 1. Provide temporary floor to ceiling partitions (not plastic sheeting) and ceilings as required to separate work areas from Owner occupied areas, to prevent penetration of dust and moisture into Owner occupied areas, to reduce construction noise, and to prevent damage to existing materials and equipment.
 - 2. Paint surfaces exposed to view from Owner occupied areas.

1.09 ODORS

- A. Work that causes excessive odors shall be performed only after coordination with the Owner's Authorized Representative. Filtering of air intakes to units may be required to prevent odors and vapors from entering the buildings.
- B. Contractor shall provide 7 days advance notice to the Owner's Authorized Representative in order for advance notice to be forwarded to building occupants. Work stoppage may occur if advance notification has not been coordinated or odors and vapors from the work are found to generate complaints from building occupants.

1.10 FIRE SAFETY

- A. Ensure that required exit routes remain unobstructed while building is occupied.
- B. Abide by all fire safety requirements for buildings under construction, alteration or demolition as required by Article 87, of the Uniform Fire Code as adopted by the State of Oregon.
- C. An emergency telephone shall be provided on site. Cellular telephone equipment is acceptable.
- D. Fire Suppression Equipment:

1. Install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers", and NFPA 241 "Standard for Safeguarding Construction, Alterations and Demolition Operations".
2. Maintain equipment in working condition with current inspection certificate attached to each.
3. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.
4. Store combustible materials in containers in fire-safe locations.
5. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways, and other access routes for fighting fires.
6. Provide continual supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.
7. When possible, relocate hot work to a designated hot work area.
8. If the materials or equipment cannot be relocated to a designated hot work area, use the least hazardous form of hot work that will get the job done and prepare the area properly.
9. Manage mobile hot work using the formal hot work permit system. (mentioned in the next bullet point and also a directive in the OSU Hot Work Safety Program)
10. Make sure both fire protection and hot work equipment work properly.
11. Train all personnel involved in hot work operations and activities so that they have the understanding, knowledge, and skills necessary to safely perform their jobs.

1.11 CONSTRUCTION AIDS

- A. Scaffolding: comply with applicable OSHA requirements.
- B. Material Handling Equipment:
 1. Provide necessary cranes, hoists, towers, or other lifting devices.
 2. Use only experienced operators.
 3. Remove equipment as soon as possible after task is ended.
 4. Coordinate placement of such equipment with Owner's Authorized Representative.
 5. Obtain required permits and meet requirement of governing authorities regarding applicable regulations.
- C. Materials or debris shall not be allowed to free fall from building.
- D. The use of chutes or conveyors must be approved by Owner.

1.12 TEMPORARY CONTROLS

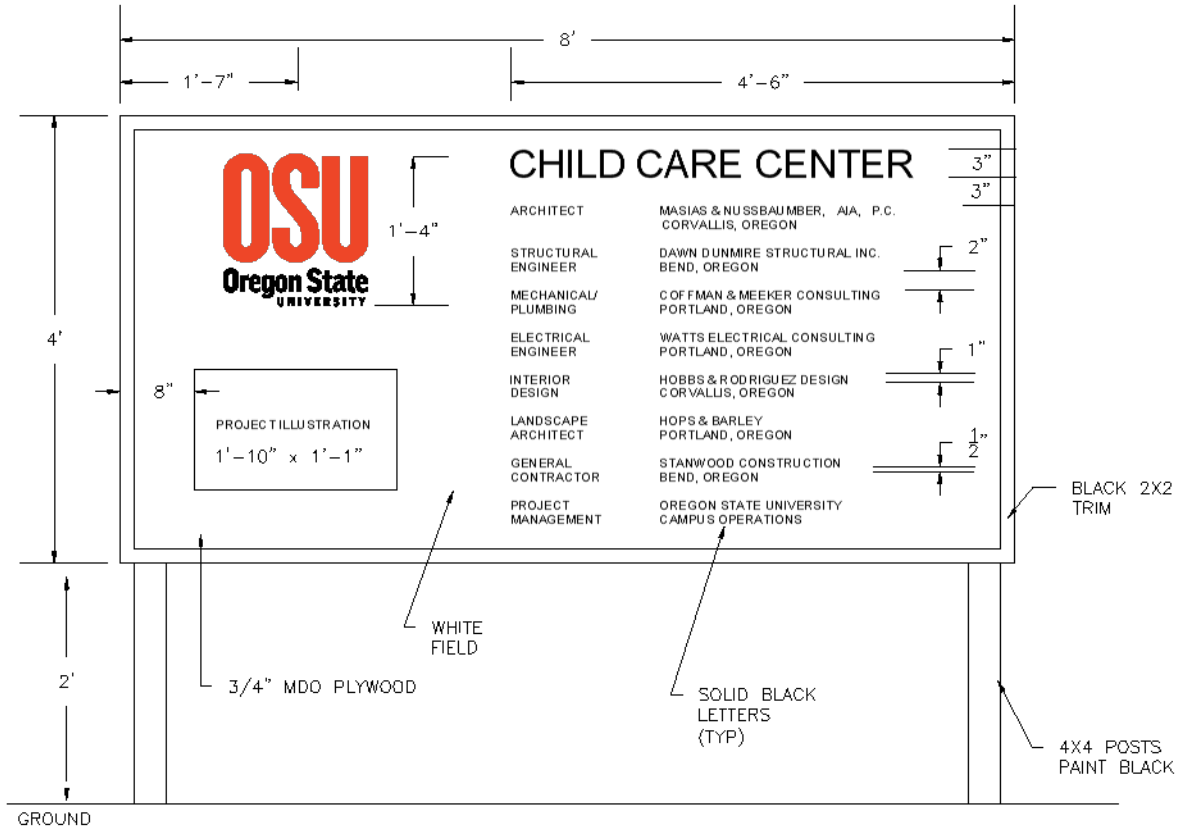
- A. Water Control:
 1. Maintain excavations free of water.
 2. Provide, operate, and maintain necessary pumping equipment.

- B. Protection:
 - 1. Protect installed Work and provide special protection where specified in individual specification sections.
 - 2. Prohibit traffic or storage upon waterproofed or roofed surfaces.
- C. Security:
 - 1. Provide security and facilities to protect Work and existing facilities and Owner's operations from unauthorized entry, vandalism, or theft.
 - 2. Coordinate operations with Owner's Authorized Representative.
- D. Temporary Traffic Control /Pedestrian Accessibility
 - 1. A continuous route for all pedestrians, including persons with disabilities and bicyclists, shall be maintained at all times. When existing pedestrian facilities are disrupted, closed, or relocated in a construction zone, temporary pedestrian facilities shall be provided.
 - 2. Temporary pedestrian facilities should be safe and accessible. There should be no curbs or abrupt changes in grade that could cause tripping or be a barrier to wheelchair use.
 - 3. Signage shall be provided directing people to the temporary accessible route. The signage shall include the International Symbol of Accessibility.
 - 4. Contractors shall not block temporary walkways with vehicles, equipment, construction materials, signs, trash, or other objects that might prohibit pedestrian passage.
 - 5. Construction equipment and equipment operation must be separated from any open walkways. At construction zones, pedestrian fences or other protective barriers shall be provided to prevent access into the construction zone.

1.13 PROJECT SIGNAGE

- A. Contractor is permitted to post only one project identification sign based on the following example:

OSU TYPICAL JOB SIGN



1.14 PREPARATION

- A. Consult with Owner to review jobsite areas required for field offices, material storage and stockpiles, equipment storage, access to different locations, etc.

1.15 PERFORMANCE

- A. Confine equipment, apparatus, and storage of material to work limits. The Owner will not be responsible for protection of materials and equipment from damage, pilfering, etc.
- B. Install temporary facilities in such a manner that the installed work will not be damaged.
- C. Do not use facilities of existing building unless authorized in writing by the Owner.
- D. Effective September 1, 2012, OSU became a non-smoking campus and smoking is prohibited on all Campus property.
- E. Keep facilities well maintained.
- F. Relocate temporary facilities as required during job progress.

- G. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period, including but not limited to:
1. Replace air filters and clean inside of ductwork and housings.
 2. Replace significantly worn parts and parts that have been subject to unusual operating conditions.
 3. Replace lamps that are burned out or noticeably dimmed by substantial hours of use.

END OF SECTION

Oregon State University Construction and Maintenance Safety Requirements

EH&S, 100 Oak Creek Building, Corvallis, OR 97331-7405, (541) 737-2273,
FAX (541) 737-9090

Complete OSU Construction and Maintenance Safety Form - Send completed documents (including Site Safety Plan and all separate answer pages) to Construction Contract Administration along with the signed contract and bonds.

Project Isolation - All construction and remodeling activities regardless of size and/or scope must be fenced, barricaded, or otherwise protected to restrict entrance and to ensure the safety of those in the general area. See isolation requirements.

Site Safety Plan - A site safety plan will be required and will address:

- General Information
- Emergency Information
- Key Organization Personnel
- Hazard Evaluation/Facility Impact
- Emergency Procedures
- Work Zones
- Security Measures
- Fire Protection

A model plan is attached. This form can be used if another plan has not already been prepared. Contact OSU Environmental Health & Safety for more information 737-2505.

Isolation Requirements

General: All construction, maintenance, and remodeling activities, regardless of size or scope, must be fenced, barricaded, or otherwise isolated to restrict entrance and to ensure the safety of those in the general area.

Outdoor Activities: Outdoor projects require the following perimeter isolation:

- A six foot chain-link fence, with controlled access points, extending in all directions around the excavation or building site such that no area of the construction is accessible to pedestrians or unauthorized personnel or vehicles.
- Isolation area will include vehicle loading and unloading areas.
- At the University's option, other barricading plans may be accepted. These may apply to projects such as road resurfacing, parking lot striping, exterior building water proofing, deliveries, etc. Contact EH&S regarding other barricading plans.

Overnight: Any excavation across or adjacent to sidewalks or pathways which must be left open overnight, must be identified with working, blinking construction lights in addition to solid barricades

Indoor Activities: Indoor construction or maintenance projects which will create dust, potentially hazardous fumes or vapors, or offensive odors are subject to the following isolation:

- Areas where existing doors can provide isolation will be labeled "Construction Area--Authorized Personnel Only".

- All other areas will be isolated by a solid barrier. The minimum barrier allowed is 4 mil poly sheeting sealed to prevent migration of dust.
- Mechanical ventilation may be required.
- A solid wall is required if building envelope is opened to the outside.

Contractor Responsibilities

- The contractor will provide all barricading, isolation, and fencing material. OSU will not provide any materials.
- The contractor will also provide all appropriate warning and detour signs when sidewalks, exits, or roads are closed.
- Contractor will provide all other construction area signs.

OSU Construction and Maintenance Safety Form

Send completed safety documents to Construction Contract Administration with contract and bonds.

Date: _____ Project: _____

Start Date: _____ Completion date: _____

Contractor: _____ Contact: _____

Work # _____ 24 hr #: _____

OSU Project Mgr: _____ Work / 24hr #'s: _____

Dept Contact: _____ OSU EH&S Contact: _____

Preconstruction meeting? **Y N** Date/Time/Location: _____

For the following items, prepare answers on a separate sheet for all items marked "Yes". Precede each answer with the appropriate item number. All boxes need to be checked

Y	N	For This Project	If YES, then:
		1 Will any confined spaces be accessed?	Describe location of entry Specify location of permit Notify EH&S prior to entry See SAF 209
		2 Will hot work be performed (welding, cutting, brazing, etc.)?	Provide min. 5# 2A10BC extinguisher within 10 ft If indoors - provide and describe ventilation See SAF 214
		3 Any products brought to campus?	Provide MSDS on site prior to first use; Make available to OSU on request
		4 Will lead paint be impacted?	Describe plan to limit contamination
		5 Will asbestos-containing-material be impacted?	Coordinate with OSU asbestos manager
		6 Will <u>any</u> materials (construction debris, soil, water, etc) be removed from campus?	Describe in detail identity and disposition of material (how, where)
		7 Any open trenches or holes?	Describe isolation procedures (see Page 1)
		8 Will a crane be used?	Describe crane safety plan (include plan to prevent loads above occupied areas)
		9 Is this project building a new facility, a major remodel?	Provide Site Safety plan Describe isolation procedures (see Page 1)
		10 Is this a minor remodeling project?	Provide, or fill out model Site Safety Plan form (see Page 3) Describe isolation procedures (see Page 1)
		11 Will air contamination be produced (e.g. dust, CO, solvent vapors, VOCs, odors)?	Describe project ventilation and isolation Indicate position of building air intake(s)
		12 Will there be noise > 85 dB?	Describe noise minimization plan
		13 Will this project use a scaffold or an external chute?	Describe isolation, dust control, installation
		14 Will this project involve a working surface >6' above a lower level	Describe fall protection
		15 Will any "blind" saw-cuts or penetrations be made in existing foundations, floors, ceilings and/or walls?	Describe plan for detecting and protecting power lines or other building utility lines.

EH&S Review: _____ Date: _____

Model Site Safety Plan

1. General Information

Contractor name _____
 Address _____
 City, State, Zip _____
 Site Safety Officer _____ Project Dates _____
 Project Name _____

2. Emergency Information

Emergency Response	911	OSU EH&S and OSU Facilities Services must be notified in the event of an emergency
Hazardous Materials Spill		
MSDS on-site location		
OSU EH&S	(541) 737-2273	
Facilities Services	(541) 737-2969	

3. Contractor Key Personnel

	Name	Phone	Emergency Contact
Company Owner			
Project Manager			
Job Supervisor			
Site Safety Officer			
Other Responsible Individual			
24 Hour Notification			

List of employees on site _____

4. Hazard Evaluation/ Facility Impact	
Physical	Yes / No
Heavy Equipment	
Noise	
Heat	
Elevation	
Radiation Materials	
Excavations	
Underground Utilities	
Confined Spaces	
Fire Prevention	
Electrical	

5. Emergencies
Services
Evacuation Route
First Aid Location
Hazardous Materials Spill Procedure

6. Work Zones

Material Storage _____
 Parking locations _____
 Individuals with OSU keys _____
 Access issues _____

7. Security measures

8. Fire protection

SECTION 01 56 39

TREE AND PLANTING PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Section includes temporary fencing, barricades, and guards to protect trees, plants and groundcovers not indicated to be removed, as necessary and required to prevent damage above and below grade.

1.02 DEFINITIONS

- A. Dripline: Outer perimeter of branches of any tree or plant.
- B. Groundcover: Includes but not limited to plants and grass.

1.03 PERFORMANCE REQUIREMENTS

- A. The Contractor shall exercise utmost care to protect existing trees and plants designated to remain and shall comply with all protection requirements provided by Owner and City of Corvallis as conveyed through the Owner's Authorized Representative.
- B. The Contractor shall install tree protection fencing as detailed and shall prevent damage to shrubs, groundcover, trees, root systems, soil, bark, foliage, branches and limbs due to construction activities, including but not limited to:
 - 1. Soil contamination, erosion, and compaction.
 - 2. Excessive wetting, and ponding due to storm water, and construction run-off.
 - 3. Alteration of grade, stockpiling of soil, debris, and materials.
 - 4. Damage to soil, roots, bark, trunk, limbs, branches, and foliage.
 - 5. Prevent unauthorized cutting, breaking, skinning and bruising of roots, branches, and bark.

1.04 SUBMITTALS

- A. Procedural proposal for tree and plant protection, describe methods of protection, and stabilization, provide drawings and supporting documentation as directed.
- B. Contractor's Condition Inspection; include written report and color photographs.

1.05 PROJECT CONDITIONS

- A. Install protection during initial mobilization at the Work site, and maintain until substantial completion.
- B. If, in the opinion of the Owner's arborist, additional protection is required, the Contractor shall install additional fencing as directed and without cost to the Owner.
- C. The location and requirements for additional fencing shall be determined by the

Owner's arborist prior to, and at any time during the course of the Work.

- D. Fencing:
 - 1. Fencing shall be installed at the tree and plant protection areas as detailed on Plans, or as directed by the Owner's Authorized Representative.
 - 2. Tree and plant protection fences shall remain in place until all Work is completed and shall not be removed or relocated without the approval of the Owner's Authorized Representative.
- E. Driving and Parking:
 - 1. Not permitted off paved surfaces without the approval of the Owner's Authorized Representative.
 - 2. When approved, the Contractor shall place plywood of sufficient thickness and width to support vehicles and prevent rutting on the area to be driven on.
 - 3. Care shall also be taken with respect to existing lawn sprinkler systems.
- F. Storage of materials and Debris: Not permitted off paved surfaces.

PART 2 PRODUCTS

2.01 MANUFACTURED COMPONENTS

- A. Chain Link Fencing: 11 gage galvanized chain link, six feet tall, and 1.5 inch inside diameter galvanized steel line posts and 2.5 inch inside diameter corner posts, provide lockable gates as necessary.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Inspect trees, plants, and groundcovers, document existing conditions prior to installation of protection.

3.02 EXECUTION

- A. Pruning and Cutting of Roots, Branches and Foliage:
 - 1. Review conditions with Architect or Owner prior to need for work, and proceed as directed.
 - 2. All pruning to be done by Owner's landscape maintenance personnel or ISA Certified arborist under the direction of Owner's Landscape Management Department.
 - 3. Perform pruning and cutting with sharp instruments intended for the purpose; do not break or chop.
- B. Root Cuttings:
 - 1. Carefully and cleanly cut roots and branches of trees indicated to be left standing

- where such roots and branches obstruct new construction.
2. Protect exposed roots with wet burlap until they can be covered with soil.
- C. Excavation and Trenching Within Drip Lines:
1. Permitted where indicated, and at other specifically approved locations.
 2. Tunnel under or around roots by hand digging or boring.
 3. Do not cut main lateral roots and tap roots over one inch diameter; cut smaller roots which interfere with installation of new Work.
 4. Do not allow exposed roots to dry out before permanent backfill is placed; provide temporary earth cover, or pack with peat moss and wrap with burlap.
 5. Water and maintain roots in moist condition and temporarily support and protect from damage until permanently relocated and covered with backfill.
- D. Existing Grading: Maintain within drip line of trees and plants unless otherwise indicated on the drawing and approved by the Owner's Authorized Representative.
- E. Tree Protection:
1. Provide temporary fence complying with Section 01 51 00 for protection of trees to remain.
 2. Extend fencing ten feet beyond dripline, except where greater distance is required for protection of Elm trees.
 3. Prevent entry into protected areas except as authorized in writing by the Owner's Authorized Representative.

3.03 REPAIR AND REPLACEMENT OF TREES AND PLANTS

- A. Repair trees or shrubs damaged by construction operations as directed by the Owner.
- B. Make repairs promptly after damage occurs to prevent progressive deterioration of damaged trees.
- C. Damaged Trees, Shrubs and Groundcover:
1. Replace where Owner's Authorized Representative determines restoration to normal growth pattern is not possible; plant and maintain as directed.
 2. Replacement trees up to 13 inches caliper and shrubs up to 4 feet tall: Same size as damaged tree or shrub, species selected by the Owner's Authorized Representative.
 3. Trees over 13 inch caliper and shrubs greater than 4 feet tall: Compensate Owner as determined by an acceptable consulting arborist registered with the American Society of Consulting Arborists.
 4. Replacement groundcovers: Same size and quality as damaged species selected by Owner's Authorized Representative.

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Summary:
 - 1. Product options.
 - 2. Owner-furnished products.
 - 3. Product delivery, storage and handling.

1.02 PRODUCTS

- A. Products:
 - 1. New material, machinery, components, equipment, fixtures, and systems forming the Work, but does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work.
 - 2. Products may also include existing materials or components specifically identified for reuse.
- B. Use interchangeable components of the same manufacture for similar components.
- C. Unless otherwise specified, all material and equipment shall be new; free from defects impairing strength, durability, and appearance; of current manufacture.
- D. Items specified shall be considered minimum as to quality, function, capacity, and suitability for application intended.
- E. Items incorporated into the Work shall conform to applicable specifications and standards designated, and shall be of size, make, type, and quality specified.
- F. Design, fabricate, and assemble in accordance with current best engineering, industry, and shop practices.
- G. Manufacture like parts of duplicate units to standard size and gauge to make them interchangeable.
- H. Two or more items of the same kind shall be identical and made by the same manufacturer.

1.03 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.
- C. Products Specified by Naming One [or More] Manufacturer[s]: Products of manufacturer[s] named and meeting specifications, no options or substitutions

allowed.

D. Substitution Procedure: Under Section 01 25 00.

1.04 REUSE OF EXISTING PRODUCTS

- A. Except as specifically indicated or specified, materials and equipment removed from existing construction shall not be used in the completed Work.
- B. For material and equipment specifically indicated or specified to be reused in the Work:
 - 1. Use care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
 - 2. Arrange for transportation, storage, and handling of products which require off-site storage, restoration, or renovation.
 - 3. Remove and reinstall mechanical units, vents, guys, antennae, and electrical and grounding wires or conduits.

1.05 OWNER FURNISHED PRODUCTS

- A. Designate delivery dates of Owner-furnished items in the construction schedule.
- B. Receive, unload, store and handle Owner-furnished items at the site; protect from damage.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Transport, handle, store and protect products in accordance with manufacturer's instructions.
- B. Arrange deliveries in accordance with construction schedules; coordinate to avoid conflict with Work and site conditions.
- C. Deliver and store products in undamaged condition in manufacturer's original containers or packaging with identifying labels intact and legible.
- D. Inspect shipments to assure compliance with Contract Documents and reviewed submittals, and that products are undamaged.
- E. Prevent soiling or damage to products or packaging.
- F. Interior Storage: Maintain required temperature and humidity ranges. Verify that Owner furnished storage meets product manufacturer's requirements.
- G. Exterior Storage:
 - 1. Store materials above ground to prevent soiling and/or moisture infiltration.
 - 2. Cover materials with waterproof breathable sheet coverings; provide adequate ventilation.
 - 3. All storage locations to be approved in advance by the Owner.
- H. Arrange storage to provide access for inspection.
- I. Coordinate with Owner's Authorized Representative all on-site storage activities.

J. Provide for security of stored products.

END OF SECTION

SECTION 01 73 29

CUTTING AND PATCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements and limitations for cutting and patching of Work.

1.02 RELATED SECTIONS

- A. Section 01 25 00, Product Substitution Procedures.
- B. Section 01 33 23, Shop Drawings, Product Data, Samples

1.03 SUBMITTALS

- A. Submit written request in advance of cutting or alteration which affects:
 - 1. Structural integrity of any element of the Work.
 - 2. Efficiency, maintenance, or safety of any operational element.
 - 3. Visual qualities of sight exposed elements.
 - 4. Work of Owner or separate contractor.
- B. Include in request:
 - 1. Identification of project.
 - 2. Location and description of affected work.
 - 3. Necessity for cutting or alteration.
 - 4. Description of proposed work, and products to be used.
 - 5. Alternatives to cutting and patching.
 - 6. Effect on work of Owner or separate contractor.
 - 7. Written permission of affected separate contractor.
 - 8. Date and time work will be executed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Primary Products: Those required for original installation.
- B. Product Substitution: For any proposed change in materials, submit request for substitution under provisions of Section 01 25 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect existing conditions prior to commencing Work, including elements subject to

damage or movement during cutting and patching.

- B. After uncovering existing work, inspect conditions affecting performance of Work.
- C. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Provide temporary supports to ensure structural integrity of the Work.
- B. Provide devices and methods to protect other portions of the Work from damage.
- C. Provide protection from elements for areas which may be exposed by uncovering work.

3.03 CUTTING AND PATCHING

- A. Execute cutting, fitting and patching to complete work.
- B. Fit products together, to integrate with other work.
- C. Remove and replace defective or non-conforming work.
- D. Provide openings in the work for penetration of mechanical and electrical work.

3.04 PERFORMANCE

- A. Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
- B. Cut rigid materials using masonry saw or core drill. Pneumatic tools are not allowed without prior approval from Owner's Authorized Representative.
- C. Restore work with new products in accordance with requirements of Contract Documents.
- D. At penetrations of fire rated walls, partitions, ceiling or floor construction, completely seal voids with approved fire rated material, to full thickness of the penetrated element.
- E. Refinishing:
 - 1. Refinish surfaces to match adjacent finish.
 - 2. For continuous surfaces, refinish to nearest intersection or natural break.
 - 3. For an assembly, refinish entire unit.

END OF SECTION

SECTION 01 74 00

CLEANING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Related requirements specified elsewhere, cleaning for specific products or work: Specification section for that work.
- B. Maintain premises and public properties free from accumulations of waste, debris, and rubbish, caused by operations.
- C. At completion of Work remove waste materials, rubbish, tools, equipment, machinery and surplus materials, and clean all sight-exposed surfaces; leave project clean and ready for occupancy.

1.02 QUALITY ASSURANCE

- A. Standards: Maintain project in accord with applicable safety and insurance standards.
- B. Hazard Control:
 - 1. Store volatile wastes in covered metal containers.
 - 2. Provide adequate ventilation during use of volatile or noxious substances.

1.03 MATERIALS

- A. Use only cleaning materials recommended by manufacturer of surface to be cleaned.
- B. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

1.04 DURING CONSTRUCTION:

- A. Wet down dry materials and rubbish to lay dust and prevent blowing dust.
- B. At reasonable intervals during progress of Work clean site and public properties, and dispose of waste materials, debris and rubbish.
- C. Provide on-site containers for collection of waste materials, debris and rubbish.
- D. Remove waste materials, debris and rubbish from site and legally dispose of at public or private dumping areas off Owner's property.
- E. Vacuum clean interior building areas when ready to receive finish painting, and continue vacuum cleaning on an as-needed basis until project is ready for Substantial Completion or occupancy.
- F. Handle materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.

1.05 FINAL CLEANING

- A. Employ experienced workers, or professional cleaners, for final cleaning.
- B. In preparation for Substantial Completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces, and of concealed spaces.
- C. Remove grease, dust, dirt, stains, labels, and other foreign materials from exposed interior and exterior finished surfaces.
- D. Remove putty, paint, labels, lubricants, etc., from windows, mirrors, and sash, and then polish, taking care not to scratch glass.
- E. Vacuum carpeting (shampoo where required), removing debris and excess nap.
- F. Repair, patch and touch up marred surfaces to specified finish, to match adjacent surfaces.
- G. Replace air filters where units were operated during construction.
- H. Maintain cleaning until project, or portion thereof, is occupied by Owner.

END OF SECTION

SECTION 01 77 00

CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 DESCRIPTION

- A. The requirements specified in this section relate to all Contractors individually performing under these Contract Documents:
 - 1. Project Record Documents.
 - 2. Final review and payment.
- B. Related work specified elsewhere:
 - 1. OSU General Conditions.
 - 2. Shop Drawings, Product Data and Samples, Section 01 33 23.

1.02 PROJECT RECORD DOCUMENTS

- A. The Project Record Documents shall be organized to include the following information, as applicable:
 - 1. Table of Contents
 - 2. Project Team List
 - 3. Specifications (Including Addenda and Change Orders)
 - 4. Drawings
 - 5. Inspection Reports
 - 6. Signed Warranty(ies)
 - 7. Maintenance Instructions
- B. Draft Project Record Documents shall be submitted for review upon 75% completion of the Work.
- C. Project Record Documents shall be submitted electronically to the Owner. Hard copies will not be accepted.
- D. The project team list shall include the name, address, and phone number of the Owner, Contractor, Inspector, Subcontractors, and the materials manufacturers.
- E. Legibly mark each Specification section to indicate actual as-built condition indicating changes in the Work made by addenda or change order or actual materials used and actual manufacturer(s) used.
- F. Maintain current and accurate as-built mark-ups during construction and make available to Owner's Authorized Representative upon request.
- G. Legibly mark the drawings to indicate actual as-built conditions indicating changes in the Work made by addenda or change order or actual conditions which differ from the drawings.
- H. Redraw or provide new drawings as required for a complete as-built set of drawings.

The Contractor shall maintain current and accurate as-built mark-ups during construction and make available to Owner's Authorized Representative.

- I. Include inspection reports if applicable.
- J. Include, in a single section, all copies of the Project's labor and material warranties clearly marked to identify the Owner's responsibilities under the terms of each warranty and the section of Work that each warranty covers. One set must be clearly marked as containing original documents.
- K. In the case of an elevator installation, the Contractor's and manufacturer's warranty shall provide for the Owner's right to respond to emergency/car failure situations for the purpose of extricating individuals trapped in the elevator.
- L. Include maintenance instructions complete with technical information and name, address, and phone number of the Contractor(s) and manufacturer(s) of each material and product.

1.03 FINAL REVIEW AND PAYMENT

- A. Prior to completion, the Contractor shall inspect the Work and make a Punch-list noting all items that are incomplete and/or incorrect.
- B. The Contractor shall notify all Subcontractors in writing of incomplete and/or incorrect items. Notify far enough in advance of the completion date that the Work can be completed on schedule. Said Work shall be immediately corrected.
- C. Should conditions prevail which prohibit some elements of the Work from being accomplished, but the work-in-place will perform the primary function (i.e., painting cannot be completed due to high moisture content of masonry walls.) the Contractor shall record the reason with this Punch-list item requesting temporary delay in completion from the Owner in writing.
- D. Notify the Owner in writing that all items are completed and ready for final review or else that the Work product is fully usable, but some listed deficiencies remain to be completed. Submit all record documents at this time.
- E. The Owner will review all documents. When the documents include a Contractor's request for delay in completion, the Owner will review all Work which is certified as complete to the best knowledge of the Contractor. The Owner will also review the listed incomplete Work and assign a value to such uncompleted work.
- F. The Contractor shall make the required corrections to the Work expeditiously. A letter will be addressed to the Contractor informing the Contractor of the project status.
- G. When Contract closeout procedures are completed and all Punch-list deficiencies have been corrected, provide Owner with final corrected Project Record Documents based on Owner's preliminary review. Correct Project Record Documents shall be in electronic format.

- H. Final Completion by the Owner will be documented and the Contractor will receive written notice of acceptance of the Work and notification that final payment may be billed and released.
- I. All warranties shall commence and become effective beginning on the date of Substantial Completion.

END OF SECTION

**SECTION 02 4100
DEMOLITION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of built site elements.
- B. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 1000 - Summary: Sequencing and staging requirements.
- C. Section 01 1000 - Summary: Description of items to be removed by Oregon State University.
- D. Section 01 1000 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- E. Section 01 51 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- F. Section 01 6000 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- G. Section 01 77 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Shop drawings, product data, samples
- B. Site Plan: Showing:
 - 1. Vegetation to be protected.
 - 2. Areas for temporary construction and field offices.
 - 3. Areas for temporary and permanent placement of removed materials.
- C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
 - 1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
 - 2. Identify demolition firm and submit qualifications.
 - 3. Include a summary of safety procedures.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Fill Material: Section 31 2333.

PART 3 EXECUTION

3.01 SCOPE

- A. Remove portions of existing buildings as indicated on drawings
- B. Remove paving and curbs as required to accomplish new work.

- C. Remove other items indicated, for salvage, relocation, and recycling.
- D. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill .

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 3. Provide, erect, and maintain temporary barriers and security devices.
 - 4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 5. Do not close or obstruct roadways or sidewalks without permit.
 - 6. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 - 7. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Oregon State University.
- C. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- D. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- E. If hazardous materials are discovered during removal operations, stop work and notify Oregon State University; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- F. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Oregon State University.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Oregon State University.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Waterleaf Architecture before disturbing existing installation.

3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Remove existing work as indicated and as required to accomplish new work.
 1. Remove items indicated on drawings.
- C. ***All hardware removed for new construction or alteration: Return to University Housing & Dining for salvage***
- D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 3. Verify that abandoned services serve only abandoned facilities before removal.
 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- E. Protect existing work to remain.
 1. Prevent movement of structure; provide shoring and bracing if necessary.
 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 3. Repair adjacent construction and finishes damaged during removal work.
 4. Patch as specified for patching new work.

3.05 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

**SECTION 06 1000
ROUGH CARPENTRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire retardant treated wood materials.
- B. Concealed wood blocking, nailers, and supports.
- C. Miscellaneous wood nailers, furring, and grounds.

1.02 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- B. AWPA C20 - Structural Lumber -- Fire Retardant Treatment by Pressure Processes; American Wood-Protection Association; 2003.
- C. PS 20 - American Softwood Lumber Standard; 2010.

1.03 SUBMITTALS

- A. See Section 01 33 23 for submittal procedures

1.04 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 - 2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.
- D. Miscellaneous Blocking, Furring, and Nailers:
 - 1. Lumber: S4S, No. 2 or Standard Grade.

2.03 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
- B. Sill Flashing: As specified in Section 07 6200.

2.04 FACTORY WOOD TREATMENT

- A. Treated Lumber: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

PART 3 EXECUTION

3.01 PREPARATION

- A. Where wood framing bears on cementitious foundations, install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches and seal.
- B. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 FRAMING INSTALLATION

- A. Select material sizes to minimize waste.
- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

3.04 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

3.05 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.06 CLEANING

- A. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

END OF SECTION

**SECTION 06 2000
FINISH CARPENTRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Finish carpentry items.
- B. Wood doors, glazed frames.
- C. Wood casings and moldings.
- D. Hardware and attachment accessories.

1.02 REFERENCE STANDARDS

- A. ANSI A135.4 - American National Standard for Basic Hardboard; 2012.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- C. PS 1 - Structural Plywood; 2009.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Shop Drawings, Product Data, Samples
- B. Product Data:
 - 1. Provide data on fire retardant treatment materials and application instructions.
 - 2. Provide instructions for attachment hardware and finish hardware.
- C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with AWI Architectural Woodwork Quality Standards Illustrated, Custom grade.
- B. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code for fire retardant requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect work from moisture damage.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

2.02 SHEET MATERIALS

- A. Softwood Plywood: PS 1 Grade A-B; Veneer core.
- B. Hardwood Plywood: HPVA HP-1 Veneer core, type of glue recommended for application.
- C. Hardboard: ANSI A135.4; Pressed wood fiber with resin binder, Class 1 - Tempered, 1/4 inch thick, smooth one side (S1S).

2.03 ADHESIVE

- A. Adhesive: Type recommended by laminate manufacturer to suit application .

2.04 WOOD TREATMENT

- A. Fire Retardant Treatment (FR-S Type): Chemically treated and pressure impregnated; capable of providing flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
- B. Wood Preservative by Pressure Treatment (PT Type): AWPA Treatment C2 using water borne preservative with 0.25 percent retainage.
- C. Provide identification on fire retardant treated material.

2.05 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

2.06 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. Apply wood filler in exposed nail and screw indentations.
- C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

- A. Set and secure materials and components in place, plumb and level.
- B. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

3.03 TOLERANCES

- A. Maximum Variation from True Position: 1/16 inch.
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION

SECTION 06 4100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wood Cabinetry
- B. Cabinet hardware.
- C. Factory finishing.
- D. Preparation for installing utilities.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 06 6100 - Cast Polymer Fabrications: Cast plastic countertops.
- C. Section 09 9123 - Interior Painting: Site finishing of cabinet exterior.
- D. Section 12 3600 - Countertops.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- C. BHMA A156.9 - American National Standard for Cabinet Hardware; 2010.
- D. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- E. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2009.
- F. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.9).

1.04 SUBMITTALS

- A. See Section 01 33 23 - Shop drawings, product data, samples
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
- C. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Quality Certification:
 - 1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 2. Provide designated labels on shop drawings as required by certification program.
 - 3. Provide designated labels on installed products as required by certification program.
 - 4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
 - 5. Replace, repair, or rework all work for which certification is refused.
- C. Perform work in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Custom quality, unless other quality is indicated for specific items.
- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum Five years of documented experience.

1.06 MOCK-UP

- A. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware, finishes, and plumbing accessories.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.08 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. TBD.
- B. Substitutions: Not permitted.
- C. Single Source Responsibility: Provide and install this work from single fabricator.

2.02 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Cabinets:
 - 1. Finish - Exposed Exterior Surfaces: TBD.
 - 2. Finish - Exposed Interior Surfaces: TBD
 - 3. Finish - Concealed Surfaces: Manufacturer's option.
 - 4. Cabinet Design Series: As indicated on drawings.
 - 5. Adjustable Shelf Loading: 50 lbs. per sq. ft.

2.03 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.

2.04 LAMINATE MATERIALS

2.05 COUNTERTOPS

- A. Countertops are specified in Section 12 3600.
- B. Solid Surface Countertop: Pental Quartz, 3 cm engineered stone slab. Color: B5182P Altea Polished; BQ400P Seashell Polished

2.06 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- C. Concealed Joint Fasteners: Threaded steel.
- D. Grommets: Standard painted metal or rubber grommets for cut-outs, in color to match adjacent surface.

2.07 HARDWARE

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.
- C. Drawer and Door Pulls: "U" shaped wire pull, steel with satin finish, 4 inch centers.

- D. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish steel with satin finish.
- E. Drawer Slides:
 - 1. Type: Standard extension.
 - 2. Static Load Capacity: Commercial grade.
 - 3. Mounting: Side mounted.
 - 4. Manufacturers:
 - a. Accuride International, Inc: www accuride.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- F. Hinges: European style concealed self-closing type, steel with polished finish.

2.08 SHOP TREATMENT OF WOOD MATERIALS

- A. Provide UL (DIR) listed and approved identification on fire retardant treated material.

2.09 SITE FINISHING MATERIALS

2.10 FABRICATION

- A. Cabinet Style: Flush overlay.
- B. Cabinet Doors and Drawer Fronts: Flush style.
- C. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- D. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

2.11 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. Sheen: TBD.
 - 2. Opaque:
 - a. Color: As selected by Waterleaf Architecture.
 - b. Sheen: TBD.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.

3.02 INSTALLATION

- A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- B. Use concealed joint fasteners to align and secure adjoining cabinet units.
- C. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- D. Secure cabinets to floor using appropriate angles and anchorages.

3.03 ADJUSTING

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

**SECTION 07 2100
BATT INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Batt insulation in interior wall and ceiling construction.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Supporting construction for batt insulation.
- B. Section 07 2500 - Weather Barriers: Separate air barrier and vapor retarder materials.
- C. Section 07 8400 - Firestopping: Insulation as part of fire-rated through-penetration assemblies.
- D. Section 09 2116 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

- A. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2012.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- C. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2012.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Shop drawings, product data, samples
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.
- D. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- E. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- F. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.05 QUALITY ASSURANCE

- A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
 - 1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.
 - 2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.06 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Insulation in Metal Framed Walls: Batt insulation with integral vapor retarder.
- B. Insulation Above Lay-In Acoustical Ceilings: Batt insulation with no vapor retarder.

2.02 BATT INSULATION MATERIALS

- A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at awarded contractors' option.
- B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
- C. Batt Insulation: ASTM C 665; preformed batt; friction fit, conforming to the following:
 - 1. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 - 2. Thickness: 3 inches thick.
 - 3. Facing: Aluminum foil, flame spread 25 rated; one side.
 - 4. Manufacturers:
 - a. CertainTeed Corporation; NA: www.certainteed.com.
 - b. Owens Corning Corp: www.owenscorning.com.
- D. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 - 1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in interior wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.03 FIELD QUALITY CONTROL

- A. Coordination of Air Barrier Association of America (ABAA) Tests and Inspections:
 - 1. Provide testing and inspection required by ABAA Quality Assurance Program (QAP).
 - 2. Notify in ABAA writing of schedule for air barrier work, and allow adequate time for testing and inspection.
 - 3. Cooperate with ABAA testing agency.
 - 4. Allow access to air barrier work areas and staging.
 - 5. Do not cover air barrier work until tested, inspected, and accepted.

3.04 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 8400
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

- A. Section 09 2116 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2015.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.
- C. ASTM E1966 - Standard Test Method for Fire Resistive Joint Systems; 2007 (Reapproved 2011).
- D. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestops; 2014b.
- E. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2010a (Reapproved 2015).
- F. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.
- G. ITS (DIR) - Directory of Listed Products; current edition.
- H. FM 4991 - Approval Standard for Firestop Contractors; 2013.
- I. FM (AG) - FM Approval Guide; current edition.
- J. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168; current edition.
- K. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
- L. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.
- M. UL (FRD) - Fire Resistance Directory; current edition.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Sustainable Design Submittal: Submit VOC content documentation for all non-preformed materials.
- E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- F. Installer Qualification: Submit qualification statements for installing mechanics.

1.05 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

- C. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
 - a. Verification of minimum three years documented experience installing work of this type.
 - b. Verification of at least five satisfactorily completed projects of comparable size and type.
 - c. Licensed by local authorities having jurisdiction (AHJ).

1.06 MOCK-UP

- A. Install one firestopping assembly representative of each fire rating design required on project.
 - 1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.
- B. If accepted, mock-up will represent minimum standard for the Work.
- C. If accepted, mock-up may remain as part of the Work. Remove and replace mock-ups not accepted.

1.07 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Firestopping Manufacturers:
 - 1. 3M Fire Protection Products; -: www.3m.com/firestop/#sle.
 - 2. A/D Fire Protection Systems Inc; -: www.adfire.com/#sle.
 - 3. Hilti, Inc; www.us.hilti.com/#sle.
 - 4. Nelson FireStop Products; -: www.nelsonfirestop.com/#sle.
 - 5. Specified Technologies Inc; -: www.stifirestop.com/#sle.
 - 6. Tremco Commercial Sealants & Waterproofing; TREMstop Acrylic: www.tremcosealants.com/#sle.
 - 7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
- C. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
- D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use any system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
- B. Through Penetration Firestopping: Use any system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

2.04 FIRESTOPPING FOR FLOOR-TO-FLOOR, WALL-TO-FLOOR, AND WALL-TO-WALL JOINTS

- A. Concrete and Concrete Masonry Walls and Floors:

1. Floor to Floor Joints:
 - a. 2 Hour Construction: UL System FF-D-1013; Hilti CFS-SP WB Firestop Joint Spray and CP 672.
 - b. 2 Hour Construction: UL System FF-D-1085; Tremco, TREMstop Acrylic Firestop Sealant.
- B. Gypsum Board Walls:
 1. Wall to Wall Joints That Have Not Been Tested For Movement Capabilities (Static):
 - a. 2 Hour Construction: UL System WW-S-0063; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.
 2. Wall to Wall Joints That Have Movement Capabilities (Dynamic):
 - a. 2 Hour Construction: UL System WW-D-0180; Specified Technologies Inc. SpeedFlex TTG Track Top Gasket.

2.05 FIRESTOPPING FOR FLOOR-TO-WALL JOINTS

- A. Floor-To-Wall Joint System That Have Movement Capabilities (Dynamic):
 1. 2 Hour Construction: UL System FW-D-1069; Tremco, TREMstop Acrylic Firestop Sealant.

2.06 FIRESTOPPING PENETRATIONS THROUGH CONCRETE AND CONCRETE MASONRY CONSTRUCTION

- A. Blank Openings:
 1. In Floors or Walls:
 - a. 2 Hour Construction: UL System C-AJ-0090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
- B. Penetrations Through Floors or Walls By:
 1. Multiple Penetrations in Large Openings:
 - a. 2 Hour Construction: UL System C-AJ-8143; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 2. Cable Trays with Electrical Cables:
 - a. 2 Hour Construction: UL System C-AJ-4094; Hilti CFS-BL Firestop Block.
 3. Insulated Pipes:
 - a. 2 Hour Construction: UL System C-AJ-5048; Hilti FS-ONE MAX Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CP 601S Elastomeric Firestop Sealant, CP 604 Self-Leveling Firestop Sealant or CFS-S SIL GG Firestop Silicone Sealant Gun-Grade.
- C. Penetrations Through Walls By:
 1. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 2 Hour Construction: UL System W-J-1067; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 2. Electrical Cables Not In Conduit:
 - a. 2 Hour Construction: UL System C-AJ-3095; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 3. Insulated Pipes:
 - a. 2 Hour Construction: UL System C-AJ-5090; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 4. HVAC Ducts, Uninsulated:
 - a. 2 Hour Construction: UL System W-J-7092; Specified Technologies Inc. FyreFlange HVAC Firestop Angle.
 5. HVAC Ducts, Insulated:
 - a. 2 Hour Construction: UL System W-J-7112; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.07 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

- A. Blank Openings:

1. 2 Hour Construction: UL System W-L-0020; Specified Technologies Inc. Composite Sheet.
- B. Penetrations By:
1. Multiple Penetrations in Large Openings:
 - a. 2 Hour Construction: UL System W-L-1408; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 2. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 2 Hour Construction: UL System W-L-1033; Specified Technologies Inc. SIL silicone sealant.
 3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
 - a. 2 Hour Construction: UL System W-L-2048; Specified Technologies Inc. SSW wrap strips.
 4. Electrical Cables Not In Conduit:
 - a. 2 Hour Construction: UL System W-L-3024; Specified Technologies Inc. SSP Firestop Putty.
 5. Cable Trays with Electrical Cables:
 - a. 2 Hour Construction: UL System W-L-4008; Specified Technologies Inc. SSB Intumescent Firestop pillows.
 6. Insulated Pipes:
 - a. 2 Hour Construction: UL System W-L-5014; Specified Technologies Inc. SSS Intumescent Firestop Sealant.
 7. HVAC Ducts, Insulated:
 - a. 2 Hour Construction: UL System W-L-7156; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.08 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
1. Fire Ratings: Use any system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by Oregon State University's Independent Testing Agency.
- C. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- D. Install labeling required by code.

3.04 FIELD QUALITY CONTROL

- A. Independent Testing Agency: Inspection agency employed and paid by Oregon State University, will examine penetration firestopping in accordance with ASTM E2174, and ASTM E2393.

- B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.05 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.06 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 07 9005
JOINT SEALERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sealants and joint backing.

1.02 RELATED REQUIREMENTS

- A. Section 09 2116 - Gypsum Board Assemblies: Acoustic sealant.

1.03 REFERENCE STANDARDS

- A. ASTM C834 - Standard Specification for Latex Sealants; 2014.
- B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Shop drawings, product data, samples
- B. Manufacturer's Installation Instructions: Indicate special procedures.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document covering installation requirements on site.

1.06 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.07 WARRANTY

- A. Correct defective work within a two year period after Date of Substantial Completion.
- B. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 SEALANTS

- A. Sealants and Primers - General: Provide products having volatile organic compound (VOC) content as specified.
- B. General Purpose Exterior Sealant: Polyurethane; ASTM C920, Grade NS, Class 25 minimum; Uses M, G, and A; single component.
 - 1. Color: To be selected by Waterleaf Architecture from manufacturer's standard range.
- C. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
 - 1. Color: To be selected by Waterleaf Architecture from manufacturer's standard range.

2.02 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D1667, closed cell PVC; oversized 30 to 50 percent larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Install bond breaker where joint backing is not used.
- D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- E. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- F. Tool joints concave.

3.04 CLEANING

- A. Clean adjacent soiled surfaces.

3.05 PROTECTION

- A. Protect sealants until cured.

END OF SECTION

SECTION 08 1113
STEEL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.

1.02 RELATED REQUIREMENTS

- A. Section 08 7100 - Door Hardware.
- B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.
- C. Section 09 9113 - Exterior Painting: Field painting.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- C. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames; 2007 (R2011).
- D. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
- E. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- F. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- H. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.
- J. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2014.
- K. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.
- L. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- M. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- N. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.
- O. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- P. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- Q. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Shop drawings, product data, samples
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- E. Manufacturer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- B. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 DESIGN CRITERIA

- A. Requirements for Hollow Metal Doors and Frames:
 1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements; Galvannealed steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
 4. Door Edge Profile: Manufacturers standard for application indicated.
 5. Typical Door Face Sheets: Flush.
 6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.
 7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.02 HOLLOW METAL DOORS

- A. Interior Doors, Non-Fire Rated:
 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 1 - Standard-duty.
 - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 20 gage, 0.032 inch, minimum.
 2. Core Material: Manufacturers standard core material/construction and in compliance with requirements.
 3. Door Thickness: 1-3/4 inch, nominal.
 4. Door Finish: Factory finished.

2.03 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. General:
 - 1. Comply with the requirements of grade specified for corresponding door.
 - a. ANSI A250.8 Level 1 Doors: 16 gage frames.
 - b. Frames for Wood Doors: Comply with frame requirements specified in ANSI A250.8 for Level 1, 18 gage
 - 2. Finish: Factory primed, for field finishing.
- C. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
 - 1. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch, maximum, above floor at 45 degree angle.
 - 2. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
- D. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- E. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

2.04 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Factory Finish: Complying with ANSI/SDI A250.3, manufacturer's standard coating.
 - 1. Color: As scheduled.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Install door hardware as specified in Section 08 7100.
- E. Comply with glazing installation requirements of Section 08 8000.
- F. Touch up damaged factory finishes.

3.03 ADJUSTING

- A. Adjust for smooth and balanced door movement.

3.04 SCHEDULE

- A. Refer to Door and Frame Schedule appended to this section.

END OF SECTION

SECTION 08 1416
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; fire-rated, non-rated, acoustical, and special function.

1.02 RELATED REQUIREMENTS

- A. Section 06 2000 - Finish Carpentry: Wood door frames.
- B. Section 08 11 13 - Hollow Metal Frames.
- C. Section 08 8000 - Glazing.
- D. Section 09 2116 - Gypsum Board Assemblies: Bullet-resistant sheathing and wallboard for bullet-resistant partitions and walls.
- E. Section 09 9123 - Interior Painting: Field finishing of doors.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- D. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- E. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2013.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Shop drawings, product data, samples
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
- B. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.07 PROJECT CONDITIONS

- A. Coordinate the work with door opening construction, door frame and door hardware installation.

PART 2 PRODUCTS

2.01 DOORS

- A. Doors: Refer to drawings for locations and additional requirements.
 - 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with WDMA I.S. 1A.
 - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.

2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
3. Maple Wood veneer facing for field transparent finish as indicated on drawings.

2.02 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- B. Sound Resistant Doors: Equivalent to type, with particleboard core (PC) construction with core as required to achieve STC rating specified; plies and faces as indicated above.

2.03 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: Match existing building standard, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
 1. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.
- B. Facing Adhesive: Type I - waterproof.

2.04 ACCESSORIES

- A. Metal Louvers:

2.05 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
- C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- E. Provide edge clearances in accordance with the quality standard specified.

2.06 FACTORY FINISHING - WOOD VENEER DOORS

- A. Finish work in accordance with WDMA I.S. 1A for grade specified and as follows:
- B. Factory finish doors in accordance with specified quality standard to match building standard.

2.07 ACCESSORIES

- A. Hollow Metal Door Frames: As specified in Section 08 1113.
- B. Glazed Openings:
 1. Heat-Strengthened and Fully Tempered Glass: ASTM C1048.
 2. Fire-Protection-Rated Glass: Safety Certification, 16 CFR 1201, Category II.
- C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
- D. Astragals for Non-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge.
- E. Astragals for Fire-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge, specifically for double doors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.

3.03 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

3.04 SCHEDULE (SEE DOOR SCHEDULE)

END OF SECTION

**SECTION 08 7105
DOOR HARDWARE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hardware for wood doors.
- B. Thresholds.
- C. Weatherstripping, seals and door gaskets.

1.02 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames.

1.03 REFERENCES

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council.
- B. BHMA A156.18 - American National Standard for Materials and Finishes; Builders Hardware Manufacturers Association, Inc. (ANSI/BHMA A156.18).
- C. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; Door and Hardware Institute.
- D. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
- E. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures; National Fire Protection Association.
- F. UBC Std 7-2, Part II - Test Standard for Smoke- and Draft-control Assemblies; International Conference of Building Officials.
- G. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc..

1.04 SUBMITTALS

- A. See Section 01 33 23 - Shop Drawings, Product Data, Samples for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate locations and mounting heights of each type of hardware, schedules, catalog cuts, electrical characteristics and connection requirements.
 - 2. Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
 - 3. Project Record Documents: Record actual locations of installed cylinders and their master key code.
 - 4. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
- B. Hardware Supplier Qualifications: Company specializing in supplying commercial door hardware with five years of experience. Company must have a factory direct status with all manufacturer's specified or approved.
- C. Hardware Supplier Personnel: Employ an Architectural Hardware Consultant (AHC) to assist in the work of this section.
- D. DELIVERY, STORAGE, AND PROTECTION
 - 1. Package hardware items individually; label and identify each package with door opening code to match hardware schedule.

1.06 COORDINATION

- A. Coordinate the work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware.

- B. Furnish templates for door and frame preparation.
- C. Coordinate Owner's keying requirements during the course of the Work.

1.07 WARRANTY

- A. See Section 01 77 00 - Contract Closeout, for additional warranty requirements.
- B. Provide ten year warranty for door closers, five year warranty for locksets and three year warranty for panic hardware.

1.08 MAINTENANCE PRODUCTS

- A. Provide special wrenches and tools applicable to each different or special hardware component.
- B. Provide maintenance tools and accessories supplied by hardware component manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers specified below are approved for work on this project. Bracketed companies () are indicated as basis for design in the Hardware Schedule.
 - 1. Hinges:
 - a. Ives (IVE).
 - b. Bommer.
 - c. Stanley.
 - 2. Lock and Latch Sets:
 - a. Schlage L series (SCH).
 - b. Best Lock 45H series (BES).
 - 3. Keying:
 - a. All keying performed by Owner.
 - 4. Closers & Auto Operators:
 - a. LCN Closers (LCN).
 - b. Stanley
 - 5. Touchless Actuators:
 - a. Camden (CAM).
 - 6. Gasketing, Thresholds:
 - a. ZER
 - b. National Guard Products, (NGP) Inc: www.ngpinc.com.
 - c. Pemko Manufacturing Co: www.pemko.com
 - d. Steelcraft.
 - 7. Protection Plates:
 - a. Ives (IVE).
 - b. Trimco.
 - c. Tice.
 - 8. Overhead Stops:
 - a. Glynn Johnson (GLY).
 - b. Rixson (RIX).
 - 9. Substitutions: See Section 01 25 00 - Product Substitution Procedures.

2.02 GENERAL REQUIREMENTS FOR DOOR HARDWARE PRODUCTS

- A. Provide products that comply with the following:
 - 1. Applicable provisions of Federal, State, and local codes.
 - 2. ANSI/ICC A117.1, American National Standard for Accessible and Usable Buildings and Facilities.
 - 3. Applicable provisions of NFPA 101, Life Safety Code.
 - 4. Fire-Rated Doors: NFPA 80.
 - 5. All Hardware on Fire-Rated Doors: Listed and classified by UL as suitable for the purpose specified and indicated.

6. Hardware for Smoke and Draft Control Doors: Provide hardware that enables door assembly to comply with air leakage requirements of UBC Std 7-2, Part II.
 7. Finishes: Identified in schedule at end of section.
- B. Provide products that meet the following manufacturing requirements in addition to being prior approved.
1. Panic Hardware shall not have any visible fasteners on the back side of the panic device case which would be visible through glass.
 2. Panic Hardware shall have roller strikes and deadlatching features.
 3. Locksets shall be furnished with proper length strikes to clear all projecting trim.
 4. Door closers shall not have internal pressure relief valves or screens.
 5. Door closers must be furnished with heavy duty arms.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that doors and frames are ready to receive work and dimensions are as indicated on shop drawings.

3.02 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Use templates provided by hardware item manufacturer.
- C. Install hardware on fire-rated doors and frames in accordance with code and NFPA 80.
- D. Mounting heights for hardware from finished floor to center line of hardware item:
1. For steel doors and frames: Comply with DHI "Recommended Locations for Architectural Hardware for Steel Doors and Frames."

3.03 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01 45 00 Quality Control.
- B. Representative for locks and closers to inspect installation and certify that hardware installation has been furnished and installed in accordance with manufacturer's instructions at no additional cost to Owner.

3.04 ADJUSTING

- A. Adjust work under provisions of Section 01 77 00.
- B. Adjust hardware for smooth operation.
- C. After building is complete and air system is balanced, door closers and operators shall be adjusted to comply with ADA, Building and Fire Codes at no additional cost to Owner.








3.05 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01 77 00.
- B. Do not permit adjacent work to damage hardware or finish.

HARDWARE GROUP NO. 01

115








PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	SET	CONST LATCHING BOLT	FB51P		630	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	CLASSROOM MORTISE LOCK	45H7R15H		626	BES
1	EA	CONSTRUCTION CORE	1CC		BLK	BES
1	EA	PERMANENT CORE	1C7		626	BES
2	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	ASTRAGAL	47A		A	ZER
2	EA	SILENCER	SR64		GRY	IVE
(OMIT AT TIMELY FRAME)						

HARDWARE GROUP NO. 02

119A







PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	KEYPAD PRIVACY LOCK	CO-200-CY-40-KP-RHO-B 4B BATTERY OPERATED		626	SCE
1	EA	CONSTRUCTION CORE	1CC		BLK	BES
1	EA	PERMANENT CORE	1C7		626	BES
1	EA	SURFACE CLOSER	4040XP REG TBWMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	GASKETING	488SBK PSA (FOR SOUND)		BK	ZER

HARDWARE GROUP NO. 03

121

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:








QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	CLASSROOM MORTISE LOCK	45H7R15H		626	BES
1	EA	CONSTRUCTION CORE	1CC		BLK	BES
1	EA	PERMANENT CORE	1C7		626	BES
1	EA	OH STOP	90S		630	GLY
1	EA	SURFACE CLOSER	4040XP RW/PA WMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	488SBK PSA (FOR SOUND)		BK	ZER

HARDWARE GROUP NO. 04

161

162

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	CONSTRUCTION CORE	1CC		BLK	BES
1	EA	CLASSROOM DEADBOLT	8T37SSTK		626	BES
1	EA	PERMANENT CORE	1C7		626	BES
1	EA	PUSH PLATE	8200 6" X 16"		630	IVE
1	EA	PULL PLATE	8302 8" 6" X 16" G		630	IVE
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	FLOOR STOP	FS436		626	IVE
1	EA	GASKETING	488SBK PSA (FOR SOUND)		BK	ZER
			BALANCE OF HARDWARE EXISTING			






RE-USE EXISTING AUTO OPERATOR & TOUCHLESS ACTUATORS.

HARDWARE GROUP NO. 05

163

164

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK W/INDICATOR	45H0L15H-VIN		626	BES
1	EA	SURFACE CLOSER	4040XP RW/PA WMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CVX		630	IVE
1	EA	GASKETING	488SBK PSA (FOR SOUND)		BK	ZER

SECTION 09 0561

COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section applies to all floors identified in the contract documents as to receive the following types of floor coverings:
 - 1. Resilient tile and sheet.
 - 2. Thin-set ceramic tile.
- B. Removal of existing floor coverings.
- C. Preparation of new and existing concrete floor slabs for installation of floor coverings.
- D. Testing of concrete floor slabs for moisture and alkalinity (pH).
- E. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- F. Remedial floor sheet membrane.

1.02 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete; 1999 (Reapproved 2014).
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2011.
- E. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.04 SUBMITTALS

- A. Visual Observation Report: For existing floor coverings to be removed.
- B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
- C. Testing Agency's Report:
 - 1. Description of areas tested; include floor plans and photographs if helpful.
 - 2. Summary of conditions encountered.
 - 3. Moisture and alkalinity (pH) test reports.
 - 4. Copies of specified test methods.
 - 5. Recommendations for remediation of unsatisfactory surfaces.
 - 6. Submit report directly to Oregon State University.
 - 7. Submit report not more than two business days after conclusion of testing.
- D. Adhesive Bond and Compatibility Test Report.
- E. Copy of RFCI (RWP).

1.05 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing will be performed by an independent testing agency employed and paid by Oregon State University.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- C. Contractor's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.
 - 2. Confirm date of start of testing at least 10 days prior to actual start.
 - 3. Allow at least 4 business days on site for testing agency activities.
 - 4. Achieve and maintain specified ambient conditions.
 - 5. Notify Oregon State University when specified ambient conditions have been achieved and when testing will start.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.07 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
 - 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
 - 2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- C. Remedial Floor Sheet Membrane: Pre-formed multi-ply sheet membrane installed over concrete subfloor and intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

- A. Perform following operations in the order indicated:
 - 1. Preliminary cleaning.

2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
 3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 5. Specified remediation, if required.
 6. Patching, smoothing, and leveling, as required.
 7. Other preparation specified.
 8. Adhesive bond and compatibility test.
 9. Protection.
- B. Remediations:
1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
 3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 REMOVAL OF EXISTING FLOOR COVERINGS

- A. Comply with local, State, and federal regulations and recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to floor covering being removed.
- B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.03 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

3.04 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
- F. Report: Report the information required by the test method.

3.05 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
- C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
- D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.06 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with requirements and recommendations of floor covering manufacturer.
- C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- D. Do not fill expansion joints, isolation joints, or other moving joints.

3.07 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.08 INSTALLATION OF REMEDIAL FLOOR SHEET MEMBRANE

- A. Install in accordance with sheet membrane manufacturer's instructions.

3.09 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 09 2116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal stud wall framing.
- B. Metal channel ceiling framing.
- C. Gypsum wallboard.
- D. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 2100 - Batt Insulation: Acoustic insulation.

1.03 REFERENCE STANDARDS

- A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- B. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014.
- C. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2015.
- D. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2013.
- E. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- G. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2014.
- H. GA-216 - Application and Finishing of Gypsum Board; 2013.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Shop drawings, product data, samples
- B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
- C. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

1.05 QUALITY ASSURANCE

- A. Perform in accordance with ASTM C 840. Comply with requirements of GA-600 for fire-rated assemblies.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code for fire rated assemblies as indicated on drawings.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.

2.02 METAL FRAMING MATERIALS

- A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
 - 1. Exception: The minimum metal thickness and section properties requirements of ASTM C 645 are waived provided steel of 40 ksi minimum yield strength is used, the metal is

continuously dimpled, the effective thickness is at least twice the base metal thickness, and maximum stud heights are determined by testing in accordance with ASTM E 72 using assemblies specified by ASTM C 754.

2. Studs: "C" shaped with flat or formed webs with knurled faces.
3. Runners: U shaped, sized to match studs.
4. Ceiling Channels: C-shaped.
5. Furring: Hat-shaped sections, minimum depth of 7/8 inch.

B. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

2.03 BOARD MATERIALS

A. Gypsum Wallboard: ASTM C 1396/C 1396M. Sizes to minimize joints in place; ends square cut.

1. Type X: Fire resistant, UL or WH rated.
 - a. Application: Vertical surfaces, unless otherwise indicated.
 - b. Thickness: 5/8 inch.
 - c. Edges: Tapered.
2. Ceiling Board: Special sag-resistant type.
 - a. Application: Ceilings, unless otherwise indicated.
 - b. Thickness: 1/2 inch.
 - c. Edges: Tapered.

2.04 ACCESSORIES

A. Acoustic Insulation: As specified in Section 07 2100.

B. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.

C. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.

1. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
2. Ready-mixed vinyl-based joint compound.

D. High Build Drywall Surfer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.

E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

F. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.

G. Screws: ASTM C 1002; self-piercing tapping type; cadmium-plated for exterior locations.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.

1. Level ceiling system to a tolerance of 1/1200.
2. Laterally brace entire suspension system.

C. Studs: Space studs at 16 inches on center.

1. Extend partition framing to structure where indicated and to ceiling in other locations.
2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

- D. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.

3.03 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- C. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
- D. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.05 JOINT TREATMENT

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 2. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. Finish all gypsum board in accordance with ASTM C 840 Level 4.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
- D. Spray apply high build drywall surfacer over entire surface after joints have been properly treated to achieve Level 5 finish in areas indicated.

3.06 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 3000

TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Cementitious backer board as tile substrate.
- D. Ceramic accessories.
- E. Ceramic trim.

1.02 RELATED REQUIREMENTS

- A. Section 07 1400 - Fluid-Applied Waterproofing.
- B. Section 09 2116 - Gypsum Board Assemblies: Installation of tile backer board.

1.03 REFERENCE STANDARDS

- A. ANSI A108/A118/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2017.
 - 1. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2014.
 - 2. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
 - 3. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement; 1999 (Reaffirmed 2010).
 - 4. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2009 (Revised).
 - 5. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
 - 6. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (Reaffirmed 2010).
 - 7. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2010).
 - 8. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2010).
 - 9. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (Reaffirmed 2010).
 - 10. ANSI A108.11-SystemDeleted - American National Standard for Interior Installation of Cementitious Backer Units; 2010 (Revised).
 - 11. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
 - 12. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2010).
 - 13. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2013 (Revised).
 - 14. ANSI A118.9-SystemDeleted - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2010).

- 15. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation; 2014.
- B. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-set Ceramic Tile and Dimension Stone Installation; 2014.
- C. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2016.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Shop Drawings, Product Data, Samples
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.

1.06 MOCK-UP

- A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
- B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
 - 1. Minimum size of mock-up is indicated on drawings.
 - 2. Approved mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

PART 2 PRODUCTS

2.01 TILE

- A. Manufacturers: All products of each type by the same manufacturer.
 - 1. Crossville
 - 2. Dal-Tile Corporation
 - 3. Substitutions: Not permitted.
- B. Glazed Wall Tile: ANSI A137.1, standard grade.
 - 1. Color(s): As indicated on Finish Schedule

2.02 TRIM AND ACCESSORIES

- A. Ceramic Accessories: Glazed finish, same color and finish as adjacent field tile; same manufacturer as tile.
- B. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
 - 1. Applications:
 - a. Open Edges: Bullnose.
 - b. Inside Corners: Jointed.
 - c. Floor to Wall Joints: Cove base.

- 2. Manufacturers: Same as for tile.
- C. Trims:
 - 1. Open edges and outside corners
 - a. Schluter Scheine stainless trim
 - 2. Floor to wall joints
 - a. Schluter DILEX - EHK. Stainless cove profile

2.03 SETTING MATERIALS

- A. Manufacturers:
 - 1. LATICRETE International, Inc; contact as required: www.laticrete.com/sle.
- B. Provide setting materials made by the same manufacturer as grout.
- C. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.
 - 1. Applications: All wet locations.
- D. Water Based Adhesive: Multi-purpose type mastic.
 - 1. Products:
 - a. LATICRETE; 300 Adhesive.
- E. Mortar Bed Materials: Pre-packaged mix of Portland cement, sand, latex additive, and water.
 - 1. Products:
 - a. LATICRETE International, Inc; LATICRETE 3701 Fortified Mortar Bed: www.laticrete.com/#sle.
 - b. LATICRETE International, Inc; Hydro Ban

2.04 GROUTS

- A. Manufacturers:
 - 1. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: www.laticrete.com/#sle.
- B. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
 - 1. Applications: All wet locations.
 - 2. Color(s): As selected by Waterleaf Architecture from manufacturer's full line.
 - 3. Products:
 - a. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout: www.laticrete.com/#sle.
- C. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
 - 1. Applications: Between tile and plumbing fixtures.
 - 2. Color(s): As selected by Waterleaf Architecture from manufacturer's full line.
- D. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
 - 1. Composition: Water-based colorless silicone.

2.05 MAINTENANCE MATERIALS

- A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
 - 1. Applications: Between tile and plumbing fixtures.
- B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
 - 1. Composition: Water-based colorless silicone.
- C. Tile Sealer: Stain protection for natural stone.
- D. Grout Release: Temporary, water-soluble pre-grout coating.

2.06 THICK-BED MATERIALS

- A. Mortar Bed Materials: Portland cement, sand, latex additive, and water.

2.07 ACCESSORY MATERIALS

- A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
 - 1. Thickness: 20 mils, maximum.
 - 2. Crack Resistance: No failure at 1/16 inch gap, minimum.
 - 3. Products:
 - a. LATICRETE International, Inc; HYDRO BAN: www.laticrete.com/#sle.
- B. Waterproofing Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
 - 1. Crack Resistance: No failure at 1/16 inch gap, minimum; comply with ANSI A118.12.
 - 2. Fluid or Trowel Applied Type:
 - a. Material: Synthetic rubber.
 - b. Thickness: 25 mils, minimum, dry film thickness.
 - c. Products:
 - 1) LATICRETE International, Inc; LATICRETE HYDRO BAN: www.laticrete.com/#sle.
- C. Backer Board: Cementitious type complying with ANSI A118.9-SystemDeleted; high density, glass fiber reinforced, 5/8 inch thick; 2 inch wide coated glass fiber tape for joints and corners.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11-SystemDeleted and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

3.03 INSTALLATION - GENERAL

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install ceramic accessories rigidly in prepared openings.
- G. Sound tile after setting. Replace hollow sounding units.

- H. Keep control and expansion joints free of mortar, grout, and adhesive.
- I. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- K. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.
- M. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.04 INSTALLATION - WALL TILE

- A. On exterior walls install in accordance with TCNA (HB) Method W244, thin-set over cementitious backer units, with waterproofing membrane.
- B. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.
- C. Over metal studs without backer install in accordance with TCNA (HB) Method W241, mortar bed, with membrane where indicated.

3.05 CLEANING

- A. Clean tile and grout surfaces.

3.06 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

3.07 SCHEDULE

- A. See Finish Schedule

END OF SECTION

SECTION 09 5100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.02 RELATED REQUIREMENTS

- A. Section 21 1300 - Fire-Suppression Sprinkler Systems: Sprinkler heads in ceiling system.
- B. Section 26 5100 - Interior Lighting: Light fixtures in ceiling system.
- C. Section 28 4600 - Fire Detection and Alarm: Fire alarm components in ceiling system.

1.03 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.
- B. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Shop drawings, product data, samples
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components.
- D. Samples: Submit two samples 6x6 inch in size illustrating material and finish of acoustical units.
- E. Samples: Submit two samples each, 12 inches long, of suspension system main runner.
- F. Manufacturer's Installation Instructions: Indicate special procedures.
- G. Maintenance Materials: Furnish the following for Oregon State University's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.08 PROJECT CONDITIONS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Install acoustical units after interior wet work is dry.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acoustic Tiles/Panels:
 - 1. Armstrong World Industries, Inc; contact as required: www.armstrong.com.

- B. Suspension Systems:
 - 1. Armstrong World Industries, Inc; contact as required: www.armstrong.com.

2.02 ACOUSTICAL UNITS

- A. Manufacturers:
 - 1. Armstrong World Industries, Inc; Product See Finish Schedule: www.armstrong.com.
- B. Acoustical Units - General: ASTM E1264, Class A.
- C. Acoustical Panels:
 - 1. Size: 24 x 24 inches.
 - 2. Size: 24 x 48 inches
 - 3. Size: 24 x 72 inches
 - 4. NRC Range: .70, determined as specified in ASTM E 1264.
 - 5. Panel Edge: Square.
 - 6. Surface Pattern: G - Smooth.
 - 7. Surface Color: White.
 - 8. Suspension System: Exposed grid.
 - 9. Surface Color: White.
 - 10. Products:

2.03 SUSPENSION SYSTEM(S)

- A. Manufacturers:
 - 1. Same as for acoustical units.
- B. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
- C. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.
 - 1. Profile: Armstrong, Supra Fine Tee; 15/16 inch wide face.
 - 2. Construction: Double web.
 - 3. Finish: White painted.

2.04 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Perimeter Moldings: Same material and finish as grid.
 - 1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
- C. Acoustical Insulation: Specified in Section 07 2100.
 - 1. Thickness: 2 inch.
 - 2. Size: To fit acoustical suspension system.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C 636, ASTM E 580, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

- D. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- G. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- H. Do not eccentrically load system or induce rotation of runners.
- I. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
 - 2. Overlap and rivet corners.

3.03 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Make field cut edges of same profile as factory edges.

3.04 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

**SECTION 09 6500
RESILIENT FLOORING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient sheet flooring.
- B. Resilient tile flooring.
- C. Resilient base.
- D. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.
- B. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, removal of existing floor coverings, cleaning, and preparation.

1.03 REFERENCE STANDARDS

- A. ASTM D6329 - Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers; 1998 (Reapproved 2015).
- B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- D. ASTM F1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing; 2004 (Reapproved 2014).
- E. ASTM F1700 - Standard Specification for Solid Vinyl Tile; 2013a.
- F. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012).
- G. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2004 (Reapproved 2014).
- H. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2015.
- I. UL 2824 - GREENGUARD Certification Program Method for Measuring Microbial Resistance From Various Sources Using Static Environmental Chambers; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Shop drawings, product data, samples
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Shop Drawings: Indicate seaming plans and floor patterns.
- D. Verification Samples: Submit two samples, 6x9 inch in size illustrating color and pattern for each resilient flooring product specified. Provide heat-welded seam samples for color and pattern combinations. Sample applied to a rigid backing and prepared by Installer for this project.
- E. Maintenance Materials: Furnish the following for Oregon State University's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Protect roll materials from damage by storing on end.
- D. Do not double stack pallets.

1.06 FIELD CONDITIONS

- A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 SHEET FLOORING

- A. Vinyl Sheet Flooring: Homogeneous without backing, with color and pattern throughout full thickness.
 - 1. Manufacturers:
 - a. Johnsonite.
 - b. Substitutions: Not permitted.
 - 2. Minimum Requirements: Comply with ASTM F1913.
 - 3. VOC Content: Certified as Low Emission by one of the following :
 - 4. Thickness: 0.080 inch nominal.
 - 5. Heat welded seams. Provide color coordinate welding rod
 - 6. .SV-1: Mannington, fine Fields, Biospec MD, Color: Gray Flannel 15370 (seamless)
- B. Vinyl Welding Rod: Solid vinyl bead produced by manufacturer of vinyl flooring for heat welding seams, in color matching field color.

2.02 TILE FLOORING

- A. Vinyl Tile: Class III, printed vinyl plank, 22 mil wear layer.
 - 1. Manufacturers:
 - a. Interface.
 - b. Substitutions: Not permitted.
 - 2. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
 - 3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
 - 4. Mold and Microbial Resistance: Highly resistant when tested in accordance with ASTM D6329; certified in accordance with UL 2824.
 - 5. Total Thickness: 0.125 inch.
 - 6. Color: As indicated on Finish Schedule

2.03 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
 - 1. Height: 4 inch / 6 inch
 - 2. Thickness: 0.125 inch.
 - 3. Finish: Satin.
 - 4. Accessories: Premolded external corners and internal corners.
 - 5. Manufacturers:
 - a. Burke Flooring: www.burkemercer.com.
 - b. Johnsonite, Inc: www.johnsonite.com.
 - c. Roppe Corp: www.roppe.com.

2.04 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Filler for Coved Base: Plastic.
- D. Sound Control Underlayment: Recycled ethylene vinyl acetate (EVA) sheet membrane with non-woven polyester fleece facer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive resilient flooring.
- C. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive coved base.
- D. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
 - 1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- E. Verify that sub-floor surfaces are dust-free and free of substances which would impair bonding of adhesive materials to sub-floor surfaces.
- F. Verify that concrete sub-floor surfaces are dry enough and ready for resilient flooring installation by testing for moisture emission rate and alkalinity in accordance with ASTM F710; obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is fully cured.
- D. Clean substrate.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Fit joints and butt seams tightly.
- E. Set flooring in place, press with heavy roller to attain full adhesion.
- F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - SOUND CONTROL UNDERLAYMENT

- A. Install in accordance with underlayment manufacturer's instructions.

3.05 INSTALLATION - SHEET FLOORING

- A. Install in accordance with manufacturer's instructions.
- B. Spread only enough adhesive to permit installation of materials before initial set.
- C. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- E. Double cut sheet at seams.
- F. Lay flooring with tightly butted seams, without any seam sealer unless otherwise indicated.
- G. Finish seams in sheet vinyl by heat welding.

3.06 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.07 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.08 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.09 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

3.10 SCHEDULE (SEE FINISH SCHEDULE)

END OF SECTION

SECTION 09 9000
PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints, stains, varnishes, and other coatings.
- C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished
- D. Do Not Paint or Finish the Following Items:
 - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Floors, unless specifically so indicated.
 - 6. Glass.
 - 7. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 05 5000 - Metal Fabrications: Shop-primed items.

1.03 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2014.
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Shop drawings, product data, samples
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum 10 years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 5 years experience.

1.07 MOCK-UP

- A. See Section 01 45 00 - Quality Requirements, for general requirements for mock-up.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Paints: Acceptable manufacturers
 - 1. Benjamin Moore & Co
 - 2. Miller
 - 3. Sherwin Williams
 - 4. Pittsburgh
 - 5. Flecto
 - 6. Rust-Oleum
- C. Primer Sealers: Same manufacturer as top coats.
- D. Block Fillers: Same manufacturer as top coats.

2.02 PAINTS AND COATINGS - GENERAL

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating. Premium grade paint labeled as 'Best'
 - 1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Supply each coating material in quantity required to complete entire project's work from a single production run.
 - 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Volatile Organic Compound (VOC) Content:
 - 1. Provide coatings that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- D. Flammability: Comply with applicable code for surface burning characteristics.

- E. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Waterleaf Architecture from the manufacturer's full line.
- F. Colors: As indicated in Color Schedule
 - 1. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Oregon State University.
 - 2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.03 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - All Interior Surfaces Indicated to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry, brick, wood, plaster, uncoated steel, shop primed steel, galvanized steel, and aluminum.
 - 1. Two top coats and one coat primer.
 - 2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143-148.
 - 3. Velvet: MPI gloss level 2; use this sheen at all locations.
 - 4. Primer(s): As follows unless other primer is required or recommended by manufacturer of top coats:
 - a. All Substrates: MPI #149, Institutional Low Odor/VOC Primer Sealer, unless a different primer is specified.
 - b. Wood: MPI #39, Latex Primer for Interior Wood.
 - c. Steel, Uncoated: MPI #107, Rust-Inhibitive Water Based Primer.
 - d. Steel -- Shop Primer: MPI #76, Quick Dry Alkyd Primer for Metal.
 - e. Galvanized Steel: MPI #134, Water Based Galvanized Primer.
- B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
 - 1. Two top coats and one coat primer.
- C. Paint I-OP-MD-WC - Medium Duty Vertical/Overhead: Including gypsum board, plaster, concrete, concrete masonry, uncoated steel, shop primed steel, galvanized steel, and aluminum.
 - 1. Two top coats and one coat primer.
 - 2. Primer(s): As recommended by manufacturer of top coats.

2.04 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin application of coatings until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. If substrate preparation is the responsibility of another installer, notify Waterleaf Architecture of unsatisfactory preparation before proceeding.
- E. Test shop-applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Plaster and Stucco: 12 percent.

3. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
5. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to coating application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- G. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- H. Plaster Surfaces to be Painted: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- I. Aluminum Surfaces to be Painted: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- J. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- K. Corroded Steel and Iron Surfaces to be Painted: Prepare using at least SSPC-SP 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).
- L. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- M. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
- N. Interior Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- O. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.
- P. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.

3.03 APPLICATION

- A. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.
- B. Apply products in accordance with manufacturer's instructions.

- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance.
- E. Sand wood and metal surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 45 00 - Quality Requirements, for general requirements for field inspection.
- B. Oregon State University will provide field inspection.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

- A. Protect finished coatings until completion of project.
- B. Touch-up damaged coatings after Substantial Completion.

3.07 SCHEDULE - COLORS (SEE FINISH SCHEDULE)

END OF SECTION

SECTION 10 1400

SIGNAGE

PART 1 GENERAL (OFOI - OWNER FURNISHED, OWNER INSTALLED)

1.01 RELATED REQUIREMENTS

- A. Section 23 05 53 - Identification for Plumbing Piping and Equipment.
- B. Section 26 0553 - Identification for Electrical Systems.

1.02 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.

PART 2 PRODUCTS

2.01 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 OSU, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Sign Type: Flat signs with engraved panel media as specified.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
 - 3. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
 - 4. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 - 5. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
- C. Interior Directional and Informational Signs:
- D. Emergency Evacuation Maps:
 - 1. Allow for one map per elevator lobby.
 - 2. Map content to be provided by Oregon State University.
- E. Building Identification Signs:

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs where indicated:
 - 1. Room and Door Signs: Locate on wall at latch side of door with centerline of sign at 60 inches above finished floor.
 - 2. If no location is indicated obtain Oregon State University's instructions.
- D. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 10 2113.16
PLASTIC-LAMINATE-CLAD TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Plastic laminate toilet compartments.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Blocking and supports.
- B. Section 10 2800 - Toilet, Bath and Custodial Accessories.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2009.
- B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- C. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- C. Product Data: Provide data on panel construction, hardware, and accessories.
- D. Samples: Submit two samples of partition panels, 6x6 inch in size illustrating panel finish, color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Plastic Laminate Toilet Compartments: Bobrick
 - 1. Substitutions: Section 01 6000 - Product Requirements.

2.02 COMPONENTS

- A. Toilet Compartments: Plastic laminate finished, floor-mounted unbraced.
- B. Doors, Panels, and Pilasters: Plastic laminate adhesive and pressure bonded to faces and edges of particleboard core, with beveled corners and edges; edges of cut-outs sealed.

2.03 ACCESSORIES

- A. Wall and Pilaster Brackets: Polished stainless steel.
- B. Hardware: Polished stainless steel:
 - 1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
 - 2. Thumb turn door latch with exterior emergency access feature.
 - 3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
 - 4. Coat hook with rubber bumper; one per compartment, mounted on door.
 - 5. Provide door pull for outswinging doors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.

- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

3.05 SCHEDULES: SEE DRAWINGS

END OF SECTION

SECTION 10 2113.19
PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Solid plastic toilet compartments.

1.02 RELATED REQUIREMENTS

- A. Section 05 5000 - Metal Fabrications: Concealed steel support members.
- B. Section 06 1000 - Rough Carpentry: Blocking and supports.
- C. Section 10 2800 - Toilet, Bath and Custodial Accessories.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall, floor, and ceiling supports, door swings.
- D. Samples: Submit two samples of partition panels, 6 by 6 inch in size illustrating panel finish, color, and sheen.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 10 year experience manufacturing similar products.
- B. Installer Qualifications: Minimum 2 year experience installing similar products.
- C. Single Source Requirements: To the greatest extent possible provide products from a single manufacturer.
- D. Accessibility Requirements: Comply with requirements applicable in the jurisdiction of the project, including but not limited to ADA and ICC/ANSI A117.1 requirements as applicable.

1.06 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard 25 year limited warranty for panels, doors, and stiles against breakage, corrosion, delamination, and defects in factory workmanship. Manufacturer's standard 1 year guarantee against defects in material and workmanship for stainless steel door hardware and mounting brackets.

PART 2 PRODUCTS

2.01 SOLID PLASTIC TOILET COMPARTMENTS

- A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid color reinforced composite (SCRC), floor-to-ceiling.
- B. Basis of Design: Bobrick SierraSeries Standard Height, Gap Free Option
 - 1. Color: Architect to select from Manufacturer's standard color options.
- C. Doors:
 - 1. Thickness: 3/4 inch.
 - 2. Width for Handicapped Use: 36 inch, out-swinging.
 - 3. Height: 58 inch.
- D. Panels:
 - 1. Thickness: 1/2 inch.
 - 2. Height: 58 inch.
- E. Pilasters:

1. Thickness: 3/4 inch.
2. Width: As required to fit space; minimum 3 inch.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Install products in strict compliance with manufacturer's written instructions and recommendations, including the following:
 1. Verify blocking and supports in walls and ceilings has been installed properly at points of attachment.
 2. Verify location does not interfere with door swings or use of fixtures.
 3. Use fasteners and anchors suitable for substrate and project conditions
 4. Install units rigid, straight, plumb, and level.
 5. Conceal evidence of drilling, cutting, and fitting to room finish.
 6. Test for proper operation.

3.03 ADJUSTING

- A. Adjust hardware for proper operation after installation. Set hinge cam on in-swinging doors to hold doors open when unlatched. Set hinge cam on out-swinging doors to hold unlatched doors in closed position.
- B. Touch-up, repair or replace damaged products.
- C. Clean exposed surfaces of compartments, hardware, and fittings.

END OF SECTION

SECTION 10 2800
TOILET, BATH AND CUSTODIAL ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.
- C. Utility room accessories.
- D. Accessories for toilet rooms, showers, and utility rooms.
- E. Grab bars.

1.02 RELATED REQUIREMENTS

- A. Section 09 3000 - Tiling

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- B. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip; 1999 (Reapproved 2009).
- C. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015a.
- D. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

- A. See Section 01 33 23 - Shop Drawings, Product Data, Samples.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Samples: Submit two samples of each accessory, illustrating color and finish.
- D. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 PRODUCTS: PROVIDED BY UHDS (OFCI)

- A. Products listed are supplied by UHDS, Facilities Services OSU standard:
 - 1. Paper Towel Dispenser
 - 2. Bathroom Tissue Dispenser
 - 3. Soap Dispenser
 - 4. Sanitary Disposal
 - 5. Seat Cover Dispenser
- B. All items of each type to be made by the same manufacturer.

2.02 PRODUCTS: PROVIDED AND INSTALLED BY GC

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 - 1. Waste Receptacle
 - 2. Grab Bars

3. Shower Accessories
4. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.
5. Adhesive: Two component epoxy type, waterproof.
6. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
7. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.

2.04 COMMERCIAL TOILET ACCESSORIES

- A. Waste Receptacle: Recessed, stainless steel, seamless lower door for access to container, with tumbler lock, reinforced panel full height of door, push-in self-closing top door, continuously welded bottom pan and seamless exposed flanges.
- B. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
 1. Size: See drawings.
- C. Grab Bars: Stainless steel, 1-1/4 inches outside diameter, minimum 0.05 inch wall thickness, nonslip grasping surface finish, concealed flange mounting; 1-1/2 inches clearance between wall and inside of grab bar.

2.05 COMMERCIAL SHOWER AND BATH ACCESSORIES

- A. Shower Curtain Rod: Stainless steel tube, 1 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 3 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for installation with exposed fasteners.
- B. Shower Curtain:
 1. Material: Opaque vinyl, 0.008 inch thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
 2. Material: Cotton, machine washable, and mildew-resistant.
 3. Grommets: Stainless steel; pierced through top hem on 6 inch centers.
 4. Color: White.
 5. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.
- C. Folding Shower Seat: Wall-mounted recessed; welded tubular seat frame, structural support members, hinges and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand seat.
 1. Seat: Teakwood slats secured to supporting frame members with stainless steel screws. Ease edges of each slat.
- D. Wall-Mounted Soap Dish: Heavy duty, seamless stainless steel, surface-mounted with drain holes, without grab bar, satin finish; with concealed mechanical fastening suitable for substrate and backplate.
- E. Towel Bar: Stainless steel, 3/4 inch square tubular bar; rectangular brackets, concealed attachment, satin finish.
- F. Towel Pin: Stainless steel, 3 inch extension from wall; rectangular-shaped bracket and backplate for concealed attachment, satin finish.
- G. Robe Hook: Heavy-duty stainless steel, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

2.06 UTILITY ROOM ACCESSORIES

- A. Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, hat-shaped channel.
 1. Holders: 3 spring-loaded rubber cam holders.
 2. Length: 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
- D. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated on drawings.
- D. Mounting Heights and Locations: As required by accessibility regulations and as indicated on drawings

3.04 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

3.05 SCHEDULE: SEE DRAWINGS

END OF SECTION

SECTION 10 4400
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 09 9123 - Interior Painting: Field paint finish.

1.03 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.
- B. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.

1.04 SUBMITTALS

- A. See Section 01 33 23 - Shop drawings, product data, samples
- B. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- C. Product Data: Provide extinguisher operational features.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

2.03 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Fire Rated Cabinet Construction: One-hour fire rated.
 - 1. Steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.
- C. Cabinet Configuration: Semi-recessed type.
 - 1. Size to accommodate accessories.
- D. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- E. Weld, fill, and grind components smooth.
- F. Finish of Cabinet Exterior Trim and Door: No. 4 - Brushed stainless steel.
- G. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Extinguisher Theft Alarm: Battery operated alarm, 10 second delay for disarming, activated by opening cabinet door.
- C. Cabinet Signage: Coordinate with owners authorized representative.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings .

END OF SECTION

SECTION 12 3200
MANUFACTURED WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured standard and custom casework, with cabinet hardware.

1.02 RELATED REQUIREMENTS

- A. Section 01 6000 - Product Requirements: Requirements for sustainably harvested wood.
- B. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: VOC limitations for adhesives and sealants.
- C. Section 06 1000 - Rough Carpentry: Blocking and nailers for anchoring casework.
- D. Section 09 2116 - Gypsum Board Assemblies: Reinforcements in metal-framed partitions for anchoring casework.

1.03 DEFINITIONS

- A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches above finished floor, tops of cases less than 72 inches above finished floor and all members visible in open cases or behind glass doors.
- B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches above finished floor and bottoms of cabinets more than 30 inches but less than 42 inches above finished floor.
- C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation and cabinets less than 30 inches above finished floor.

1.04 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- C. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2009.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Keying Conference: Conduct conference prior to ordering keys. Incorporate conference decisions into keying submittal.

1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements, placement dimensions and tolerances, clearances required, and keying information.
- C. Maintenance Data: Manufacturer's recommendations for care and cleaning.
- D. Finish touch-up kit for each type and color of materials provided.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.
- B. Acceptance at Site:
 - 1. Do not deliver or install casework until the conditions specified under Part 3, Examination Article of this section have been met. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.
- C. Storage:
 - 1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the environmental requirements specified under Part 3, "Site Verification of Conditions" Article of this section.

1.09 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion, at no additional cost to Oregon State University. Defects include, but are not limited to:
 - 1. Ruptured, cracked, or stained finish coating.
 - 2. Discoloration or lack of finish integrity.
 - 3. Cracking or peeling of finish.
 - 4. Failure of hardware.

PART 2 PRODUCTS

2.01 CASEWORK, GENERAL

- A. Quality Standard: AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Wood Veneer Faced Cabinets: Custom Grade.

2.02 FABRICATION

- A. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.
- B. Construction: As required for selected grade.
- C. Seismic Performance: Casework, including attachments to other work, able to withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Component Importance Factor: 1.0.
- D. Fittings and Fixture Locations: Cut and drill components for fittings and fixtures.
- E. Hardware Application: Factory-machine casework members for hardware that is not surface applied.
- F. Access Panels: Where indicated, for maintenance of utility service and mechanical and electrical components.
- G. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- H. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
- I. Matching Wood Grain: Comply with requirements of quality standard for specified grade and as follows:

2.03 WOOD-VENEER-FACED CASEWORK

- A. Wood-Veneer-Faced Casework: Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base cabinets.

1. Style: Flush overlay. Ease doors and drawer fronts slightly at edges.
2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions:
3. Finishes:
 - Exposed Exterior Surfaces: Match existing, Maple, plain sliced, random-matched.
 - a. Semi-Exposed Surfaces: HPVA HP-1 Grade B, Maple, plain sliced, random-matched.
 - b. Concealed Surfaces: Manufacturer's option.
 - c. Factory-finish all exposed and semi-exposed surfaces with the same finish.
 - 1) Preparation: Wood sanded smooth, free from dust and mill marks.
 - 2) Coating: Clear, superior-quality, chemical-resistant acyclic urethane; applied in accordance with manufacturer instructions, force-dried, sanded and wiped clean.
 - 3) Coats: Multiple coats as required to achieve minimum 1.5 mil dry film thickness.
 - 4) Appearance: Clear satin gloss; not cloudy or muddy.

2.04 CABINET HARDWARE: MATCH OSU STANDARD

PART 3 EXECUTION

3.01 PREPARATION

- A. Large Components: Ensure that large components can be moved into final position without damage to other construction.

3.02 EXAMINATION

- A. Site Verification of Environmental Conditions:
 1. Do not deliver casework until the following conditions have been met:
 - a. Building has been enclosed (windows and doors sealed and weather-tight).
 - b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
 - c. Ceiling, overhead ductwork, piping, and lighting have been installed.
 - d. Installation areas do not require further construction.
- B. Verify adequacy of support framing and anchors.
- C. Verify that service connections are correctly located and of proper characteristics.

3.03 INSTALLATION

- A. Perform installation in accordance with manufacturer's instructions.
- B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.
- C. Set casework items plumb and square, securely anchored to building structure.
- D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.
- E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:
 1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
 2. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
 3. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
 4. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
- F. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- G. Install hardware uniformly and precisely.
- H. Countertops: Install countertops intended and furnished for field installation in one true plane, with ends abutting at hairline joints, and no raised edges.
- I. Replace units that are damaged, including those that have damaged finishes.

3.04 ADJUSTING

- A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

3.05 CLEANING

- A. Clean casework and other installed surfaces thoroughly.

3.06 PROTECTION

- A. Do not permit finished casework to be exposed to continued construction activity.
- B. Protect casework and countertops from ongoing construction activities. Prevent workmen from standing on, or storing tools and materials on casework or countertops.
- C. Repair damage, including to finishes, that occurs prior to Date of Substantial Completion, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION

SECTION 12 3600
COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Countertops for architectural cabinet work.
- B. Wall-hung counters and vanity tops.

1.02 RELATED REQUIREMENTS

- A. Section 06 4100 - Architectural Wood Casework.
- B. Section 22 4000 - Plumbing Fixtures: Sinks.

1.03 REFERENCE STANDARDS

- A. ANSI A161.2 - Performance Standards for Fabricated High Pressure Decorative Laminate Countertops; 1998.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014.
- D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0; 2016.
- E. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- F. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.
- G. MIA (DSDM) - Dimensional Stone Design Manual; VIII, 2016.
- H. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- I. PS 1 - Structural Plywood; 2009.

1.04 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Specimen warranty.
- B. Shop Drawings: Complete details of materials and installation; combine with shop drawings of cabinets and casework specified in other sections.
- C. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.
- D. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- E. Installation Instructions: Manufacturer's installation instructions and recommendations.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- B. Fabricator Qualifications: Same fabricator as for cabinets on which tops are to be installed.
- C. Installer Qualifications: Fabricator.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAc/WI (AWS) or AWMAc/WI (NAAWS), unless noted otherwise.
- B. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin self-supporting over structural members.
 - 1. Flat Sheet Thickness: 1-1/4 inch, minimum.
 - 2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Manufacturers:
 - 1) Pentalquartz.
 - 2) Substitutions: Not permitted.
 - b. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with the MIA Dimension Stone Design Manual.
 - c. Finish on Exposed Surfaces: Polished.
 - d. Color and Pattern: See Finish Schedule.
 - 3. Other Components Thickness: 3/4 inch, minimum.
 - 4. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
 - 5. Skirts: As indicated on drawings.
 - 6. Fabricate in accordance with AWI/AWMAc/WI (AWS) or AWMAc/WI (NAAWS), Section 11 - Countertops, Premium Grade.

2.02 MATERIALS

- A. Wood-Based Components:
 - 1. Wood fabricated from old growth timber is not permitted.
- B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.
- C. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

2.03 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 - 1. Join lengths of tops using best method recommended by manufacturer.
 - 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
 - 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 - 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 - 2. Height: 4 inches, unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
- D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Waterleaf Architecture of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.
- B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
- C. Field Joints: 1/8 inch wide, maximum.

3.05 CLEANING

- A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 22 00 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.01 APPLICABLE REQUIREMENTS

- A. All work to be furnished and installed under this section shall comply with Division 01 – General Requirements when available. If not available, the Contractor shall meet the requirements of these specifications.
- B. Where the Owner-Contractor Agreement contradicts this division, the more stringent shall apply.

1.02 RELATED REQUIREMENTS

- A. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, off/from:
 - 1. State of Oregon:
 - a. OAR Oregon Administrative Rules
 - b. OESC Oregon Electrical Specialty Code
 - c. OFC Oregon Fire Code
 - d. OMSC Oregon Mechanical Specialty Code
 - e. OPSC Oregon Plumbing Specialty Code
 - f. OSSC Oregon Structural Specialty Code
 - g. ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings
 - h. Oregon Elevator Specialty Code

1.20 GENERAL

- A. Work included in 22 00 00 applies to Division 22 work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of plumbing systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications, Drawings, Addenda, Owner/Engineer Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. In the event there is a discrepancy between the drawings, specifications, and current code, the more stringent shall apply.
- D. Examine the Drawings, specifications and other Contract Documents relating to the Work and the work of all trades and become fully informed as to the extent and character of work required. Coordinate all work with that of others to ensure proper and complete installation of all materials, equipment and supports.
- E. Contractor shall visit the site and verify the exact conditions relating to the work and obtain such information as may be necessary to present a complete and comprehensive

bid. No allowance will be made for any extra expense due to Contractor's failure to make such a visit and reasonably verify all actual/existing conditions. In the event of a conflict between existing conditions and the requirements of the Contract Documents, perform the necessary work to conform to Design Intent. The Owner or his representative will be the sole individual to interpret the intent of the Drawings in the event of a conflict between (1) existing conditions and those shown on the drawings, or (2) quality of existing material and quality of material indicated on the drawings or in the specifications. Wherever a conflict such as this occurs, the higher standard shall prevail.

- F. Make complete system installation, connecting to all equipment shown on the plans, or called for in the specifications. Contractor to provide any additional extra valves not shown on plans to obtain design criteria as required for a complete system and by the balancing contractor.
- G. Drawings:
 - 1. Drawings do not attempt to show all aspects of building construction, which will affect the installation of the systems. The drawings are diagrammatic and do not intend to show all offsets and fittings that may be required for a complete installation. Locations of equipment, pipes, valves, traps, ductwork, etc. shown on the drawings, shall be followed as closely as conditions will permit. Review all project drawings, including, but not limited to, architectural, structural, plumbing and electrical drawings; and coordinate with all trades involved so there is no conflict with work of other trades and so Owner secures best arrangement of work consistent with use of space.
 - 2. Verify exact distances between points shown on drawings by actual measurement at site, as no extra cost will be allowed for differences between actual measurements and scaled measurements.
 - 3. Changes in design, configuration, or location of equipment, piping, or ductwork, advisable in the opinion of Contractor, shall be submitted to Architect/Engineer for approval before proceeding with work, with written assurance from other trades that such changes will not interfere with their installation, nor cause any extra cost on their part. Such changes shall be made at no additional cost to Owner.
 - 4. Check location of all work of all trades and avoid interferences. Conflicts shall be reported to Architect/Engineer for decision and direction. Special attention is called to the following items:
 - a. Exact location of outlets shown on architectural details.
 - b. Location of suspended ceilings.

1.21 SPECIAL REQUIREMENTS

- A. When applicable, Contractor acknowledges the ongoing operations of the Owner at or in close proximity to the Project and agrees to coordinate the timing of the Work with the Owner's ongoing operations; perform the Work in a manner that minimizes or eliminates and adverse impact upon the Owner's ongoing operations; confine operations at the site to areas approved by Owner, permitted by law, permits and the Contract Documents; comply with the Owner's standard security, health and safety policies and procedures; not unreasonably encumber the site with any materials or equipment; and not place signs or advertising on or about the site without prior approval of Owner.

- B. Where applicable, all seismic construction, restraints, bracing, mounts and hanging systems shall be in full compliance with the requirements of all Authorities Having Jurisdiction (AHJ's), pre-approval, certification and engineering (including certified engineering calculations and stamps). Contractor shall be solely responsible for obtaining and complying with all requirements of the AHJ.

1.22 DEFINITIONS AND ABBREVIATIONS

- A. Finished Spaces: Spaces other than mechanical, plumbing and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical, electrical and plumbing equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include spaces above hard or lay-in type ceilings and in duct shafts.
- E. 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.
- F. The word "provide," means "furnish and install."
- G. The word "approved," means acceptance by the Architect or Engineer.
- H. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the drawings, or other paragraphs or schedules in the specifications, and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the reader locate the reference. Location is not limited.
- I. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted," mean directed by the Architect/Engineer, requested by the Architect/Engineer, and similar phrases.

1.23 REFERENCE STANDARDS AND GUIDELINES

- A. Include but are not limited to the latest adopted editions from:
 - 1. ADA Americans with Disabilities Act
 - 2. AHRI Air-Conditioning Heating & Refrigeration Institute
 - 3. AMCA Air Moving and Conditioning Association
 - 4. ANSI American National Standards Institute
 - 5. ARI Air Conditioning and Refrigeration Institute
 - 6. ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers
 - 7. ASME American Society of Mechanical Engineers
 - 8. ASPE American Society of Plumbing Engineers

9. ASSE American Society of Sanitary Engineering
10. ASTM American Society of Testing Materials
11. AWWA American Water Works Association
12. AWS American Welding Society
13. CFR Code of Federal Regulations
14. CISPI Cast Iron Soil Pipe Institute
15. EPA Environmental Protection Agency
16. FM Factory Mutual Engineering Corporation
17. GAMA Gas Appliance Manufacturers Association
18. IAPMO International Association of Plumbing & Mechanical Officials
19. ISO International Organization for Standardization
20. MSS Manufacturers Standardization Society
21. NEBB National Environmental Balancing Bureau
22. NEC National Electric Code
23. NEMA National Electrical Manufacturers Association
24. NFPA National Fire Protection Association
25. OSHA Occupational Safety and Health Administration
26. SMACNA Sheet Metal and Air Conditioning Contractors National Association, Inc.
27. UL Underwriters Laboratories

1.24 SCOPE

- A. The work includes, but is not necessarily limited to, the furnishing of all labor, materials, equipment, tools, appliances, hoisting, scaffolding, supervision, for the proper execution and completion of the plumbing work and services necessary for, and reasonably incidental to, providing and installing complete piping systems, plumbing systems, and other plumbing work as shown or indicated in the Drawings and Specifications.
- B. The contractor is responsible for a complete and operational system installation. Contractor shall provide all necessary components for a complete and operational system even if such components are not specified or shown in the drawings or specifications. The contractor shall notify the Architect/Engineer of such mission for resolution prior to system installation.
- C. All new equipment and products as noted in Part 2 of each section shall be installed as per manufacturer's recommendations.
- D. Provide all additional piping, caps, and valves not shown on drawings, to maintain fully operational systems during the project at no additional cost to the owner.
- E. Consult all other Sections to determine the extent and character of this work specified elsewhere.
- F. Make all connections to equipment requiring service from systems installed under this Section.

1.25 SUBMITTALS

- A. Reference Division 1 for submittal requirements when available. If not available the contractor shall meet the requirements of these specifications.
- B. General
1. Review is for general conformance with the Contract Documents and is not intended to otherwise approve or verify dimensions, quantities, or to coordinate the Work shown on shop drawings on or between Contractor and the work of other trades or Sections. Contractor is solely responsible for quantities, dimensions, means and methods. Dimensions shall be confirmed and correlated by Contractor at the jobsite prior to the start of the Work (procurement, fabrication, construction or other commencement activities). Contractor's failure to fully verify conditions at the jobsite prior to commencement of the work shall not relieve Contractor of its obligations under the Contract Documents and Contractor shall be responsible for all damages caused by or related to its failure to comply with the requirements of this provision.
 2. Submittal review shall be performed to show compliance with the design intent. Contractor shall specifically note any deviations from the Contract Documents and explain the reason and nature of the deviation. Such deviations will be reviewed or rejected on the submittal. Deviations not so identified shall not relieve the Contractor from the requirements of the Contract Documents.
 3. Resubmittals will be reviewed for compliance with comment(s) made on the original submittal only. Architect/Engineer shall not be responsible for changes made upon resubmittal that are not clearly identified (highlighted), and responsive directly to the initial rejection. Resubmittals should not be packaged with non-related first-time submittals, all resubmittals must be marked with the resubmittal number and date and must otherwise comply with all submittal requirements.
 4. Submit shop drawings, commissioning plan(s) and checklists, penetration locations, supplemental data, etc. as may be required by the Contract Documents for all materials, equipment and other components of the work included in all Sections of this Division and other provisions of the Contract Documents in accordance with the requirements of this Division and referenced sections.
 5. All submittals must be reviewed by Contractor, and bear Contractor's review stamp and signoff for Conformity to the Contract Documents, prior to the submission of any required submittal to Architect/Engineer. Submittals that fail to meet this requirement will be considered incomplete, will not be reviewed by Architect/Engineer and will be returned to Contractor, without review and/or rejected and resubmittal will be required. Contractor shall be solely responsible for any and all Additional Review Costs and/or other project costs or schedule impact.
 6. Forward all submittals to Architect/Engineer in a coherent, organized fashion, complete and packaged as required herein, Architect/Engineer may reject submittals that fail to comply with this or any other provision of the Contract Documents and Contractor shall be solely responsible for any and all Additional Review Costs and/or other project costs or schedule impact.
 7. Subject to other provisions of the Contract Documents and in the absence of a more stringent requirement, Architect/Engineer will review a submittal not more than two (2) times. If a submittal is required to be reviewed more than twice due to incomplete, or incorrect information the contractor shall be solely responsible for any and all Additional Review Costs and/or other project costs or schedule impact.

8. Identify each submittal item by reference to Specification Section paragraph in which item is specified, or drawing/detail number, as applicable. In addition, for equipment submittals, include identification numbers appearing on the equipment schedule.
 9. Identify each item by manufacturer, brand, trade name, number, size, rating, or whatever other data is necessary to properly identify and check materials and equipment. Words “as specified” are not sufficient identification.
 10. Organize submittals in same sequence as they appear in specification sections, articles or paragraphs.
 11. All materials and equipment submittals shall have a summary sheet at the front complete with catalog numbers. Where materials or equipment pertain to more than one building, submittals shall clearly indicate at which locations the materials or equipment is to be installed.
 12. Submittals shall show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping and/or conduit entrance, access requirements for installation and maintenance, physical size and dimension, electrical characteristics and requirements, foundation/curbs and all permanent and temporary support details as well as all information relating to weight, including but not limited to live and dead weights and other information necessary for component verification and coordination with other trades.
- C. Submittal Schedule – Provide a detailed submittal schedule including all requirements of this Division and its subdivisions to the Architect and Engineer within thirty (30) days of contract award.
1. Contractor shall submit for the Engineer’s approval a Submittal Schedule for the performance of the work that is consistent with the requirements of the project schedule. The Submittal Schedule shall allow reasonable time for the Architect and other consultants review. If the time for Architects/Engineers review is not otherwise specified, the review period (from date of receipt) shall be a minimum of ten (10) business days. Once approved by the Architect/Engineer, submittal dates and time limits established by the Submittal Schedule shall not, except for reasonable cause, be changed or exceeded by the Contractor.
 2. For each submittal required by the Contract Documents, the schedule shall include: specification section number, subsection/paragraph identification number, item description (as stated in the applicable specification section, subsection or other Contract Document) and the scheduled delivery date to the Architect/Engineer.
 3. Contractor shall be responsible to the Architect/Engineer and/or Owner for all costs, expenses and impact to the project schedule resulting from any deviation to the approved Submittal Schedule, including but not limited to: payment for required overtime, out-of-house resources/consultants or other higher cost resources of the Architect/Engineer as may be required to perform out of sequence, stacked, critical, delayed, unscheduled or multiple reviews of required submittals necessitated by rejection of a prior submittal, (cumulatively and hereinafter, “Additional Review Costs”)
- D. Catalog Cuts & Submittal Literature
1. Catalog cuts, submittal literature and published material may be included to supplement scale drawings provided that the actual make and model of equipment being submitted on is identified.

2. Submittal literature, drawings and diagrams shall be specifically applicable to this project and shall not contain extraneous material or optional choices. Clearly mark literature to indicate the proposed item.
- E. Shop Drawings:
1. Shop drawings shall include all significant systems, equipment and components, including but not limited to all equipment, devices, connections and elevations. Include all related specialty rooms (i.e. mechanical, electrical, data/technology). Drawings shall be at a minimum scale of ¼" per 1'-0" and shall be fully coordinated with the work of other trades and/or sections.
 2. Identify congested areas and clearly indicate solutions to space problems, developed in conjunction with the work of other trades and/or Sections. Identification of space problems without proposed solutions is not acceptable and is grounds for rejection. For such areas indicate, superimposed, the work of all trades and/or Sections involved and:
 - a. Clearly identify each area of congestion and deviations from the Contract Documents, and:
 - b. Proposed solution(s), clearly documented and signed-off by all other trades and/or Sections involved.
- F. Anchorage and Supports: Submit details and calculations for support and anchors that are not specifically detailed on the drawings. All calculations must meet current seismic and structural code.
1. Provide details and calculations for equipment per local adopted building codes:
 - a. Having an operating weight over 400 pounds or more and mounted directly to the floor.
 - b. Having an operating weight over 20 pounds and suspended from the roof, floor, or wall or supported by vibration isolation devices.
 2. Where pre-approved bracing systems will be employed, submit:
 - a. System component brochure describing components used and detailed installation instructions.
 - b. Loads to be transmitted to the structure at anchor points.
 3. Where anchorage, support, and bracing are not detailed on the drawings, and pre-approved systems are not used, submit details and calculations of proposed systems. Include:
 - a. Anchorage and Supports
 - 1) Where equipment substitutions change the weight, size, configuration, or other aspects of systems and equipment that will affect the performance of anchorages and/or supports, submit calculations for proposed anchors and supports, and install them as shown in these calculations.
 - 2) Where substitutions will have no effect on anchors and supports detailed on Contract Documents, submit information on sizes, weights, center of gravity and other relevant information to demonstrate this fact.

- G. Shop Fabrication Drawings: Drawings are for the Contractor's use and shall be its responsibility. Do not submit shop fabrication documents unless specifically requested.
- H. Testing: Coordinate Shop Drawings to include any additional components for proper system testing.
- I. Certificates: Submit final inspection certificates signed by governing authorities.
- J. Operating and Maintenance Instructions and Manuals.
 - 1. Three (3) complete sets of instructions containing the manufacturer's operating and maintenance instructions for each piece of equipment shall be furnished to the Owner within ninety (90) days of issuance of final occupancy permit. Each set shall be electronic or permanently bound with a hard cover. The following identification shall be inscribed on the covers, "OPERATING AND MAINTENANCE INSTRUCTIONS", the name and location of the building, the name of the Contractor, and the Contract number. Flysheets shall be placed before instructions covering each subject. The instruction sheets shall be approximately 8 1/2" x 11" with large sheets of Drawings folded in.
 - 2. Instructions on major items, including but not limited to: pumps, air compressors, water heaters, water softeners, specialty units, controls, shall be by representative of manufacturer of respective equipment.
 - 3. Submit as identified below and as noted in other specification references.
 - a. Names, addresses and phone numbers of contractors and subcontractors. List of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
 - b. Complete operating and maintenance instructions and parts lists of all equipment and component parts. Data sheets to show all connections, ratings, characteristics, wiring connections, catalog data on component parts whether furnished by equipment manufacturer or others, names, addresses and telephone numbers of source of supply for parts subject to wear or failure, and description of operating, test, adjustment, and maintenance procedures.
 - 1) Where data sheets included in manual cover equipment, options, or other features not part of equipment actually furnished, line out these references or otherwise clearly mark so remaining text, diagrams, drawings, schedules, and similar information shall apply specifically to equipment furnished.
 - c. Operating Instructions should include, but not be limited to:
 - 1) Normal starting, operational and shutdown procedures, including emergency procedures for each type of equipment/system.
 - 2) Equipment wiring and control diagrams.
 - 3) All other items as may be specified/required by this Section and the Contract Documents.
 - d. Maintenance Instructions
 - 1) All items as may be specified/required by this Section and the Contract Documents.
 - e. Manufacturers Data (each piece of equipment)

- 1) Installation instructions
- 2) Drawings & specifications
- 3) Parts List, including recommended stock and long lead parts/components.
- 4) Wiring and riser diagrams.
- 5) Warranties and guarantees for all equipment, materials and components, including repair, replacement and labor from both Contractor and manufacturer as required by the Contract Documents.
- 6) Certificates of Installation – manufacturer’s certification of supervision during equipment installation and start-up procedures.
- 7) All other items as may be specified/required by this Section and the Contract Documents.

K. Record Documents.

1. Maintain one (1) complete set of prints and specifications at the job site exclusively for recording deviations from the drawings which are necessary because of job conditions, request for information and/or approved change orders. Record locations and depths of buried and concealed system components from fixed, easily identifiable objects, such as building walls or other fixed physical objects. Where systems are concealed in walls or other fixed physical objects, indicate distances from building corners or other building features not likely to be disturbed by fixture alterations.
2. Submit Record Drawings within 90 days of system acceptance by owner.

L. Drawings, specifications (as-builts) and approved submittals.

1. Where the project uses a BIM model the contractor shall keep the model updated in a similar fashion, maintaining the current project record as described above and submit, in addition to all other requirements of this Section and other provisions of the Contract Documents a complete and accurate BIM model for the project.
2. Prior to Substantial Completion, obtain from the Architect a complete set of printed drawings at the Contractor’s cost. Record all revisions to these drawings to indicate as-built conditions. Indicate all changes, including RFI’s, on this set of documents. Submit one set of blueprints of these revised drawings for review. Make necessary changes and deliver to Architect one set of electronic documents, including any BIM model, upon Final Completion and Acceptance.
3. All test reports, certifications, and inspection reports.
4. AHJ/Specialty AHJ Approvals (i.e. Fire Marshal and/or Fire Department system approvals).
5. Substantial and Final inspection certificate signed by governing authorities.
6. All other items as may be specified/required by this Section and/or other provisions of the Contract Documents.

1.26 EQUIPMENT DEVIATIONS AND SUBSTITUTIONS

- A. Substitutions will only be considered after project award. No substitutions will be considered during bid and/or negotiation periods.

- B. No substitutions will be allowed and/or considered unless the description of a product includes the phrase “approved equal” and then only upon a determination as to equivalency and impact upon the project budget, schedule and the work of others, including any redesign of the project or its system components by the Architect, Engineer or other trades. The final determination as to sufficiency or acceptance of any such substitution and/or deviation properly requested and submitted by Contractor will lie solely with the Architect/Engineer. Contractor may not implement substitutions that have not been approved by Architect/Engineer.
- C. Unless specified elsewhere in the Contract Documents, a minimum of two (2) weeks shall be allowed for evaluation of any substitution. The burden of all systems re-engineering/design, testing, suitability and constructability is solely placed upon the Contractor for all deviations from the basis of design as reflected in the Contract Documents.
- D. If approved by Architect/Engineer, all such redesign, including all new drawings and detailing required, will be prepared by the Architect/Engineer and their sub-consultants for Change Order documentation for approval by Owner and the Authority Having Jurisdiction will be paid by the Contractor as part of the Deviation Review Costs.
- E. When the Engineer approves a substitution, the approval is given with the understanding that the Contractor guarantees the article or material substituted to be equal to or better in every respect than the article or material specified. The Contractor shall also assume complete responsibility that the article or material will fit the job as far as space, access, and servicing requirements.
- F. Where several materials are specified by name for one use, select for use any of those so specified subject to compliance with specified requirements.
- G. Whenever item or class of material is specified exclusively by detail specification, trade name, manufacturer's name or by catalog reference, use only such item, unless written approval is given. Submit written requests in accordance with these and referenced specifications.
- H. Make no substitutions for materials, articles or process required under contract unless written approval is obtained.

1.27 COORDINATION

- A. Prior to construction, coordinate installation and location of systems, devices and equipment with architectural and structural requirements, and other trades (including ceiling suspension, and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Drawings and corresponding electronic media are diagrammatic and indicate the general arrangement of systems and work included in the Work. Consult the drawings, details and other electronic media for locations of fixtures and equipment; where same are not definitely located, obtain this information from the Architect/Engineer.
- C. Take all dimensions from Architectural and Structural Drawings, certified equipment drawings and from the actual field measurements before fabricating work. All conflicts shall immediately be reported to the Architect/Engineer. Contractor is solely responsible for conflicts known or which reasonably should have been known but not reported or resolved before commencement of the work.

- D. Coordinate connection of systems with interior/exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- E. Before submitting a bid for the work the Contractor shall visit the site and become familiar with all the work on other related Drawings and Specifications, and plan the work to provide the best possible assembly of the combined work of all trades. No additional costs will be considered for work which has to be relocated due to conflicts with other trades.
- F. If, after examination of the bidding documents relating to the work, the Contractor has queries concerning the nature and scope of the work or intent of the Specifications, he/she shall promptly request clarification from the Architect/Engineer. After contract award, claims of ignorance of the intent and scope of the contract shall not be allowed.
- G. Contractor is responsible for coordinating the schedule of inspections by Engineer at appropriate stages of construction such as rough-in, pre-final, and final, and at other times required by the Specifications or by the construction. Notify Architect and Engineer seven (7) days in advance of proposed site visit. Notification constitutes certification that construction is, or will be, complete and ready for observation. In the event that construction is not ready for observation, contractor shall bear the cost of additional site visits.

1.28 COORDINATION DRAWINGS

- A. Detail major elements, components, systems, equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
 - 1. Planned system distribution layout, including specialty device locations and access for operation
 - 2. Clearances for installing and maintaining insulation.
 - 3. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 - 4. Equipment and accessory service connections and support details.
 - 5. Other systems installed in same space.
 - 6. Exterior wall and foundation penetrations.
 - 7. Fire-rated wall and floor penetrations.
 - 8. Ceiling and wall-mounted access doors and panels required to provide access to operating devices or items needing access for proper maintenance
 - 9. Sizes and location of required concrete pads and bases.
 - 10. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
 - 11. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

1.29 SEQUENCING AND SCHEDULING

- A. Coordinate equipment installation with other building components.

- B. Arrange for space, chases, slots, and openings in building structure during progress of construction to allow for distribution system installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate, and integrate installations of all materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Some equipment may require temporary installation during one phase and require relocation to final location under another phase. Provide all associated labor and materials to accommodate this phasing.
- F. Coordinate connection of all systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate requirements for access panels and doors if items requiring access are concealed behind finished surfaces. Access panels and doors will be required.

1.30 ACCESSIBILITY

- A. Contractor is responsible for verifying that equipment and devices will fit within the space shown on the drawings. Contractor shall locate all equipment which must be serviced, operated or maintained, in fully accessible locations.
- B. Minor deviations from the drawings may be made to allow for better accessibility, but changes of magnitude or which involve extra cost shall not be made without approval from the Architect/Engineer.

1.31 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed shall conform with all local, State, Federal and other applicable laws and regulations.
- B. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- C. Installer Qualifications: Company specializing in performing the work of this section. Company personnel shall be approved by manufacturer for all product installations and required training.
- D. Conform to all applicable standards, codes and regulation and industry best practice requirements.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. All materials and equipment shall be new, shall bear manufacturer's name, and shall conform to the grade, quality and standards specified herein. Type, capacity and application shall be suitable and capable of satisfactory operation for the purpose intended. All equipment and components shall include UL label and/or marking on equipment body/device including manufacturer's name, pressure rating(s), electrical classification(s), limits and ratings as applicable to individual components for the purpose specified and intended.
- G. Equipment Selection: Equipment allowed by the specifications but with different electrical characteristics, physical dimensions, capacities, and/or ratings than what is shown on the

Drawings may be furnished, provided such proposed equipment is approved in writing and connecting plumbing and electrical services, such as pipe and/or duct connection sizes, circuit breakers, conduit, motors, bases, and equipment spaces are revised to accommodate such equipment. Maintain a minimum duct length of three straight diameters at all fan inlets and outlets. All expenses shall be borne by the Contractor. Specified minimum energy ratings and/or equipment efficiencies must meet design and commissioning requirements.

- H. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.
- I. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.
- J. Listing and labeling: Provide motors that are listed and labeled. Terms "listed and labeled": as defined by UL, NEC, Article 100 or other applicable recognized agency as specified in the Contract Documents.
- K. Cutting & Patching: Unless otherwise required by the Contract Documents, Contractor shall be responsible for all cutting, fitting and patching required to complete the Work, or to make portions of the Work and existing conditions fit together properly, and all such areas shall be restored to the conditions existing prior to the cutting, fitting and patching unless otherwise provided in the Contract Documents
- L. Lead Free Requirements: Contractor shall endeavor to use lead free products and where required by law, ordinance, regulation or standard all materials products and practices shall comply with limitations and requirements as to the allowable limits and/or percentages of lead. Lead free products must be certified by and independent 3rd party.
 - 1. This provision shall apply to any and all similarly regulated materials, products and practices that may be considered hazardous or are otherwise regulated by applicable law, ordinance regulation or standard in the project local.

1.32 DELIVERY, STORAGE, AND HANDLING

- A. All materials and equipment shall be adequately covered and protected against dirt, water, chemical or mechanical damage, and theft. At completion, all work, equipment and materials shall be cleaned, and damage repaired by Contractor. Damaged equipment will be replaced by the contractor if Owner does not accept repairs done to the equipment. Such replacement shall be scheduled to minimize building system interruption of occupied or scheduled for occupancy.
- B. Material delivered at the site shall not be left exposed to the weather or left unattended. Deliver pipes, tubes and conduit with factory-applied end-caps. Contractor shall be responsible to maintain end-caps or provide temporary end caps on all open-ended piping, tubes and conduit through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- C. Protect bright finished shafts, bearing housings and similar items until in service.
- D. Protect plastic pipes and materials from sunlight and support to prevent sagging and bending.
- E. Elevate stored materials above grade. When stored inside, do not exceed structural capacity of the floor.
- F. Provide protective coatings to materials to prevent damage and/or infiltration of moisture and dirt on all materials and equipment including but not limited to cast iron and steel valves.

- G. Contractor shall check the openings in the building and the size of the doors, passages, and openings through which equipment is to be admitted. Wherever necessary, he shall provide the equipment in sections or knocked down in order to admit the equipment through these openings.
- H. Contractor shall provide all rigging, erection and hoisting equipment as required to handle or place equipment and piping in position. This rigging and hoisting equipment shall only be attached and placed on the structure in locations as approved by Architect/Engineer at the site.

1.33 PERMITS AND FEES

- A. Contractor shall arrange and pay for all permits, fees, and inspections required to perform the Work. The Contractor shall present the Owner with properly signed certificates of final inspection before the Work will be accepted.
- B. Contractor shall call for all inspections by local building official(s) when they become due, and shall not cover any work until approved by these governing authorities.
- C. Contractor shall make all arrangements with utility companies for water, steam, gas and drainage services, etc., associated with the work and include required payments for meters, piping, services, connection charges and materials furnished and installed by utility companies. Work and materials shall be in strict accordance with rules of respective authorities.

1.34 DOCUMENT OWNERSHIP

- A. The Drawings and Specifications, combined with the calculations, field data, notes, and reports, are the intellectual and real property of the Architect and/or Engineer. This covers all forms of written and recorded or electronic media. The reuse of these documents without specific permission of the Architect and Engineer is prohibited. The Drawings may be employed by the Owner and Contractor for the express use of constructing, commissioning and operating the facility only upon proper execution of an Agreement for Use of Electronic Files & Data.

1.35 GUARANTEE AND WARRANTY

- A. Contractor warrants to Owner that the materials and equipment provided under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects. Work, materials and equipment not conforming to these requirements, including substitutions not properly approved by Change Order, shall be considered defective. This warranty excludes remedy for damage caused by improper or insufficient maintenance, improper operation or normal wear, tear and usage. Contractor shall assign to Owner, or otherwise assure the Owner has the full benefit of, all warranties and guarantees of manufacturer, subcontractors, sub-subcontractors and suppliers, and Contractor shall perform the Work in a manner that does not adversely affect or invalidate any available warranties or guarantees.
- B. Contractor shall warrant and guarantee all work against faulty material or workmanship for a period of one (1) year from the date of final completion and written acceptance by the Owner, unless specified more stringently elsewhere in the Contract Documents.
- C. If the project is occupied or the systems placed in operation in several phases at the request of the Owner, the guarantee of each system or piece of equipment used shall begin on the date each system or piece of equipment was placed in satisfactory operation, tested,

commissioned and accepted, in writing, by the Owner. The use of building equipment for temporary service and testing or phases of work completed prior to the projects final completion and acceptance by the Owner does not constitute the commencement of the warranty period.

- D. If a defect or deficiency in the Work is discovered within the one (1) year Warranty & Guarantee period or within such longer period as may be prescribed by the Laws or by any specific guarantee, and Owner elects to have Contractor correct such defect or deficiency, Owner shall notify Contractor of such defect or deficiency in writing. This period of correction relates only to the specific obligation to correct defects and deficiencies and in no way otherwise limits the Contractor's responsibility for Work that is not in accordance with the Contract Documents, If Contractor fails to timely correct defects or deficiencies in the Work, Owner may, at its sole option, correct them and charge contractor for all cost therefore.
- E. Specific exclusions, if any, from this one (1) year warranty and guarantee period are listed in the individual specification sections.

1.36 LIMITATIONS OF LIABILITY

- A. To the extent any of the following provisions are not more stringently included in the Contract Document the following Limitations of Liability shall apply:
- B. Architect/Engineer is not responsible for Contractor's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, and is not responsible for Contractor's failure to perform or furnish the work in accordance with the Contract Documents.
- C. In the event that Architect/Engineer's employees or sub-consultants make comments or issue warnings about safety issues, such comments and warnings shall be considered to have been offered by a Good Samaritan and shall not impose any obligation or responsibility.
- D. Engineer will not be responsible for the acts or omissions of Owner, Contractor, any subcontractor, any supplier, or of any other person or organization performing or furnishing any of the portions of the work
- E. Contractor understands and acknowledges that Engineer is not authorized to order extra work or issue Change Orders to the work, however in the event and to the degree that Engineer may offer advice, suggestions, and opinions Contractor shall not rely on such advice, suggestions, and opinions unless directed in writing by Owner or its designated representative, and shall, in no event, make any claim against the Engineer for any such advice, suggestions, and opinions.
- F. To the fullest extent permitted by law, Contractor shall indemnify and hold harmless Architect, Engineer, and their joint ventures, officers, directors, partners, employees and agents from and against any and all claims, costs, loses and damages (including but not limited to all fees and charge of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) caused in whole or in part by the negligent acts or omissions of Contractor, Contractor's officers, directors, partners, employees, agents; or contractor's subcontractors or material men in the performance of Work. Contractor shall direct its insurer to list Architect, Engineer, and their joint ventures, as Additional Insureds on general liability insurance policies covering this project. Prior to commencing work, Contractor shall submit copies of its certificate of insurance to both Architect and Engineer.

1.37 SAFETY

- A. Contractors must conduct a weekly safety meeting with their employees and provide documentation as to attendance and topics of discussion. Engineer's construction support services do not constitute review or approval of Contractor's safety procedures. Contractor shall comply with all OSHA regulations. Contractor is required to obtain and pay for insurance required to cover all activities within Contractor's Scope of Work.

1.38 TEMPORARY CONSTRUCTION WATER

- A. The Plumbing Contractor shall make all arrangements and provide necessary facilities for the temporary construction water from the Owner's source. Costs for the temporary construction water shall be paid for by Owner.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. See Drawings for equipment data, capabilities, and requirements. Manufacturers are identified for the purpose of establishing quality; alternative manufacturers of equal quality are acceptable. If alternative manufacturers are proposed it is the contractor's responsibility to verify and demonstrate the proposed alternative is equivalent.
- B. Provide like items from one manufacturer, including but not limited to pumps, fans, valves, control devices, air handlers, vibration isolation devices, etc.

2.02 MATERIALS

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL approved or have adequate approval or be acceptable by State, County, and City authorities. Provide all materials omitted herein but necessary to complete the work.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. All electrical materials shall bear the label of, or be listed by, the Underwriters' Laboratories (UL), unless the material is of a type for which label or listing service is not provided.
- D. Hazardous Materials: Comply with local, State of Oregon, and Federal regulations relating to hazardous materials. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

2.03 ACCESS PANELS

- A. Confirm Access Panel requirements in individual Division 22 sections. Comply with the following:
 - 1. Provide flush mounting access panels for service of systems and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly. Ceiling access panels to be minimum of 24 x 24 or as required and approved size. Wall access panels to be minimum of 12 x 12 or as required and approved size.

2.04 PENETRATION FIRE STOPPING

- A. Through-penetration fire stopping system tested and listed by Underwriters Laboratories. 3M, Metacaulk, SpecSeal, or approved equivalent.
- E. Select system for proper application based on wall construction, type of penetrating item, wall rating, etc.

PART 3 EXECUTION

3.01 GENERAL PLUMBING INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of plumbing systems, materials, and equipment. Comply with the following requirements:
 - 1. Coordinate systems, equipment, and materials installation with other building components.
 - 2. Verify all dimensions by field measurements.
 - 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for system installations.
 - 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 - 5. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 - 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 - 7. Coordinate connection of systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
 - 8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
 - 9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 - 10. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
 - 11. Install access panel or doors where units are concealed behind finished surfaces. Coordinate with other divisions.
 - 12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.02 CONTINUITY OF SERVICE

- A. Contractor, in the performance of the Work shall plan for and incorporate into the work the continuity of services. Where the continuity of service(s) is required to be interrupted Contractor shall plan and schedule the work to minimize interruptions to the facility and its normal operations, prearrange and coordinate all outages/interruptions with Owner's representative, utilities and the work of others. Requests for system interruptions/outages must be submitted at least (5) days prior to intended shutdown time and then subject to Owner's adjustment and/or approval.
- B. For connections that require a significant interruption to facility operations (as determined by the Owner), Contractor shall provide for Owner's written approval a detailed plan, schedule and description of the work for each system interruption. The plan shall include a description and schedule of each work item to be completed, designation of site supervisor and contact information, designated work crew as well as facility access and egress points for materials, manpower and equipment, contingency plan for parts, materials and equipment as well as a program to restore systems in the event of unplanned disruption or inability to complete the work in the timeframe scheduled and approved by Owner. Contractor shall confirm scheduled dates with the Owner and provide a minimum of five (5) days advance notice for each operation.
- C. Where possible and subject to Owners sole discretion, connections to existing systems shall be performed during normal operating conditions. Unless required otherwise (specifications, code, practice, etc.) all tap connections shall be 'live', 'wet' or 'hot', with the proper safety programs and procedures for isolating system components to ensure the safety of the workforce, occupants and the facility.
- D. Contractor shall include all costs for overtime labor, expedited materials, equipment and contingency planning as necessary to maintain continuity of services, schedule and complete necessary connections. Contractor shall also include provisions for maintaining any and all supplemental systems that may be required to remain in service for the safety, protection and critical operations of the facility and its occupants including but not limited to: Fire Alarm, Security, Phone/Data, BAS, Emergency Power and similarly related critical or emergency systems. Such provisions shall include but not be limited to temporary power, lighting, materials, equipment and/or installations (including removal and cleanup thereof) required to maintain such systems and as required to safely and properly complete the work.
- E. Contractor shall be liable for any and all damages resulting from unscheduled outages/interruptions or for those not confined to the pre-approved timeframes to complete the work.

3.03 DEMOLITION

- A. Comply with individual Division 22 sections and the following:
 - 1. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas.
 - 2. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
 - 3. Equipment: Unless otherwise directed, equipment, fixtures, or fittings being removed as part of demolition process are Owner's property. Remove other items not scheduled to be reused or relocated from job site as directed by Owner.

4. Unless specifically indicated otherwise on Drawings, remove exposed, unused systems to behind finished surfaces (floor, walls, ceilings, etc.). Cap and patch surfaces to match surrounding finish.
 5. Unless specifically indicated otherwise on Drawings, remove unused equipment, fixtures, fittings, rough-ins, and connectors. Removal is to be to a point behind finished surfaces (floors, walls, and ceilings).
- B. If duct, pipe, insulation, conduits, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
 - C. Reuse of Materials: Reuse of materials is prohibited unless specifically indicated or approved by Architect.
 - D. Notify Architect in discovery of any hazardous materials.
 - E. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.04 PIPING SYSTEMS - COMMON REQUIREMENTS

- B. General: Install piping systems as described below, unless piping Sections specify otherwise. Individual Division 22 piping Sections specify unique piping installation requirements.
- C. General Locations and Arrangements: 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.
- D. Install piping at indicated slope.
- E. Install components with pressure rating equal to or greater than system operating pressure.
- F. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
- G. Install piping free of sags and bends.
- H. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- I. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- J. Install piping to allow application of insulation plus 1-inch clearance around insulation.
- K. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- L. Install flexible connectors according to manufacturer's written instructions and where indicated and specified in other Division 22 sections.
- M. Install flexible expansion loops according to manufacturer's written instructions and where indicated and specified in other Division 22 sections.
- N. Install fittings for changes in direction and branch connections.
- O. Install couplings according to manufacturer's written instructions.
- P. Do not route piping over electrical panels, transformers, switchgear or other electrical equipment.

- Q. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish. Use split-casting escutcheons if required, for existing piping.
 2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 4. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
 5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.
- R. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
- S. Exception: Extend sleeves installed in floors of Plumbing equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
1. Build sleeves into new walls and slabs as work progresses.
 2. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS.
 - b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. If available, refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with non-shrink, nonmetallic grout.
 - d. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
- T. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and Plumbing sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing Plumbing sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
 3. Assemble and install Plumbing sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- U. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using Plumbing sleeve seals. Size sleeve for manufacturer's recommended clear space between pipe and sleeve.

1. Assemble and install Plumbing sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
 2. Caulk exterior side of annular space once the Plumbing sleeve seal is in place using an elastomeric joint sealant.
- V. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials. If available, Refer to Division 7 Section "Firestopping" for materials.
- W. Verify final equipment locations for roughing-in.
- X. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- Y. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
 4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 5. 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:
 6. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 7. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 8. Align threads at point of assembly.
 9. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 10. 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.
 - a. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators.
 - b. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench to recommended torque values.
- Z. Piping Connections: Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.
5. Piping Identification:
 - a. Apply color coded polyvinyl chloride pipe bands identifying service and direction of flow.
 - b. On exposed piping, apply bands at 20'-0" on centers at straight runs, at valve locations, and at points where piping enters and leaves a partition, wall, floor, or ceiling.
 - c. On concealed piping installed above non-removable ceiling construction, or in pipe shafts, apply bands at valves or other devices that are made accessible by means of access doors or panels.
 - d. Apply bands at exit and entrance points at each piece of equipment.
 - e. Band widths shall be 8" for pipes up to 10" diameter, and 16" for larger diameter piping. Letter heights stating service shall be pre-printed on band, 3/4" high for 8" bands and 1 1/4" high for 16" bands.
 - f. Colors shall conform to ASA Standard A13.1.
 - g. Tags and bands shall be approved for this service.

3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.
- B. Install equipment according to approved submittal data.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install Plumbing 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.
- E. Mechanical Drawings are diagrammatic and are intended to show the approximate location of equipment and piping. Dimensions shown on Drawings shall take precedence over scaled dimensions on Drawings. All dimensions shall be verified in the field by the Contractor.
- F. The exact location of apparatus, equipment, and piping shall be ascertained from the Owner or the representative in the field, and work shall be laid out accordingly. Should the Contractor fail to ascertain such locations the work shall be changed at Contractor's own expense when so ordered by the Owner. The Engineer reserves the right to make minor changes in the location of piping and equipment up to the time of installation without additional cost.

- G. It is the intention of the Drawings and Specifications that, where certain mechanical items such as unions, expansion joints, and other mechanical components are not shown, but where such items are required by the nature of the work, shall be furnished and installed.
- H. The Mechanical Drawings and Specifications are intended to supplement each other. Any material or labor called for in one shall be furnished even though not specifically mentioned in the other.
- I. Pipe and duct sizes shown are the minimum allowable and shall be increased in size if required by code or wherever necessary to meet unusual conditions.

3.06 DAMAGE

- A. Repair any damage to the building, premises, and equipment occasioned by the work under this Section.
- B. Repair all damage to any part of the building or premises caused by leaks or breaks in pipe, or malfunctions of equipment furnished or installed under this Section until the warranty period expiration date.

3.07 ELECTRICAL REQUIREMENTS - CONTROLS AND COORDINATION WITH ELECTRICAL CONTRACTOR

- A. Contractor shall coordinate with the Electrical Contractor on furnishing and installing of controls, motors, starters, etc. Coordinate means informing Electrical Contractor of items requiring electrical connection, providing copies of submittal data, installation data, scheduling work to insure efficient progress, and promptly supplying those items to be installed by Electrical Contractor.
- B. The specific requirements for electrical power and/or devices for each and every piece of mechanical and plumbing equipment requiring electrical service, supplied and/or installed under this Contract, shall be coordinated and verified with the Mechanical and Plumbing Drawings, the Mechanical and Plumbing Sections of these Specifications, and with the manufacturers of the mechanical and plumbing equipment supplied. This shall include the voltage, phase, and ampacity; conduit requirements; and exact location and type of disconnect, control, and/or connection required. Any changes from the Drawings and Specifications required as a result of this coordination shall be part of this Contract.
- C. Electrical Contractor shall furnish and install the following for all mechanical equipment:
- D. Conduit and wiring for line voltage power to the equipment.
 - a. Disconnect switches.
 - b. Manual motor starters.
 - c. Magnetic motor starters when part of a motor control center. See Division 26 and Drawings for further information.
- E. The work under this Section shall include furnishing and installing all controls on low and manual line voltage, including thermostats, auxiliary switches, relay wiring, interlock wiring; equipment control panels and transformers; and controls conduit unless specifically indicated as part of other work. Materials and methods of the control installation shall be in accordance with the Electrical Specifications.
- F. The Mechanical Contractor shall review all wiring connections which have any influence on this equipment or work and verify that these connections are correct before permitting any equipment to be operated which is furnished, installed, or modified under this Contract.

3.08 CUTTING AND REPAIRING

- A. No cutting shall be done except with approval. Cutting of structural members or footings is prohibited without the prior written consent of the Structural Engineer.
- B. Where cutting of paving, walls, ceilings, etc. is necessary for the installation of the mechanical work, it shall be done under the direction of this Section. Damage caused by this cutting shall be repaired to match original and adjacent surfaces without additional expense to the Owner. Cutting of new construction shall be by the installing Contractor of that construction as directed by this Contractor.

3.09 ACCESSIBILITY

- A. General: Valves, damper operators, filters, thermometers, pressure gauges, clean-out fittings, and indicating equipment or specialties requiring reading, adjusting, inspection, repairing, removal, or replacement shall be conveniently and accessibly located with reference to finished building. Thermometers and gauges installed to be easily read from floor.
- B. Panels: No unions, flanges, valves, dampers, controls, or equipment shall be placed in a location that will be inaccessible after the system is complete. Access panels or doors shall be provided where required whether or not shown on Drawings.
- C. Access Panels in Walls or Ceilings:
 - a. Provide access panels in walls or ceilings. Milcor or approved equal, where indicated and where required to provide access to valves, dampers, and other appurtenances. Panels shall be style as selected by and as directed by wall or ceiling construction. Panel size shall be 24" x 24" unless indicated otherwise. Panels in acoustical barriers shall have same transmission loss as barrier. Panels in rated construction shall have same rating as construction in which installed.
 - b. Door panels shall be no lighter than 14 gauge steel. Doors shall be equipped with concealed spring hinges and flush, screwdriver operated locks, except that key operated locks shall be used for all access doors in walls where door is within 6'-0" of floor. Locks for all key operated doors shall be keyed alike.
 - c. Doors in ceramic tile surfaces shall be stainless steel or chrome plated. Doors in other finished surfaces shall be prime coated.
- D. Equipment Spaces: Provide aisles between equipment and piping, ducts, electrical gear, etc. for complete service and inspection of equipment. Maintain minimum 6'-6" headroom in all access aisles. Maintain minimum 36" clearance at all service panels. Provide minimum clearances at electrical equipment per NEC. Provide 36" wide, 3/4" thick plywood covered catwalks in attics from access door to equipment.

3.10 TESTING

- A. Test all piping, ductwork, equipment, and systems as called for in the Specifications. Notify and inspection authorities prior to testing so that they may be witnessed. Protect all personnel and equipment during testing. Where Specifications do not cover specific points or methods, conform to manufacturer's specifications.

3.11 OPENINGS

- A. Locating and sizing of all openings for pipe, conduit and ductwork through walls, roof, etc. shall be done under this Division. Framing of openings shall be done by the respective trades in whose work the opening is made.

3.12 EQUIPMENT

- A. All equipment shall be accurately set and leveled. Supports shall be neatly placed and properly fastened. All equipment shall be fastened in place with bolts.
- B. Keep all openings closed with plugs or caps to prevent entrance of foreign matter. Protect all piping, ductwork, fixtures, and equipment against dirt, water, chemical, or mechanical damage both before and after installation. Any equipment or apparatus damaged prior to final acceptance shall be restored to original condition or replaced at the discretion and at no additional cost to the Owner.
- C. Start-Up: Equipment shall be adjusted, lubricated, aligned, etc. prior to start-up. Inspect each piece of equipment prior to start-up. Start each piece of equipment in accordance with manufacturer's directions and warranty requirements.
- D. Finish: Protect all equipment and materials until in use. Any visible rust or corrosion shall be removed as directed prior to installation. All damaged factory painted finishes shall be cleaned and painted with manufacturer provided paint.

3.13 MANUFACTURER'S DIRECTIONS

- A. Materials and equipment shall be installed in accordance with manufacturer's application and recommendations, requirements, and instructions, and in accordance with Contract Documents. Where manufacturer's instructions differ from those indicated or specified, they shall be brought to attention for resolution prior to equipment ordering and installation.
- B. Where requirements indicated in Contract Documents exceed manufacturer's requirements, Contract Documents shall govern.

3.14 FURRING AND PIPE SPACES

- A. Spaces provided in the design of the building shall be utilized and the work shall be kept within the furring lines established on the Drawings.
- B. Layout: Maintain maximum head room under piping and equipment. Contractor to coordinate line locations with beams, windows, etc. to provide maximum clearance. From Drawings, ascertain heights of suspended ceilings and size of pipe shafts in which piping is concealed, and location and size of structural members in and adjacent to pipe shafts. Coordinate piping installation with ductwork, lighting, and other equipment. Ensure necessary clearances on trim plates at exposed penetrations of walls and floors. If sufficient room is not available above suspended ceiling or vertical shafts obtain clarification from before work is started.

3.15 CLEAN-UP

- A. During the course of work under this Section, all rubbish, debris, surplus materials, tools, etc. resulting from this work shall be removed from work area and shall be disposed of off-site at the end of each working day. The Owner's premises shall be left clean and in a condition acceptable to the .
- B. Clean all work installed under this Contract to satisfaction of Owner and submit documentation that each system has been cleaned and results witnessed by the representative.
- C. All water distribution and piping systems, including those for cold water and hot water systems, shall be flushed thoroughly until piping is cleaned to satisfaction of the . See other Specification Sections for additional requirements.

3.16 ENGRAVED NAMEPLATES

- A. Furnish and install plastic laminated engraved nameplates with 1/4" minimum lettering at panel mounted control devices, manual control stations, power disconnects, motor starters and pieces of equipment. Nameplates exposed to weather shall be engraved brass.

3.17 FINAL INSPECTION

- A. The Contractor shall furnish the certificates of final inspection and approval from the inspection authorities having jurisdiction.

3.18 SITE VISITS BY ENGINEER

- A. Engineer's responsibility is limited to normal construction support services only, consisting of office consultation, site visits, and reports at appropriate stages of construction such as rough-in, pre-final, and final.
- B. If the Engineer is requested for a site visit and the work performed to that point is not able to be reviewed, requiring an additional site visit, all costs incurred by the Engineer for additional site visits or office shall be paid for by that Contractor.

END OF SECTION

SECTION 220719

PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- B. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Supplies and drains for handicap-accessible lavatories and sinks.

1.03 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing 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 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.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.06 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.07 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

- A. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.
 - 3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.
 - c. Manson Insulation Inc.
 - d. Owens Corning.
 - e. Insert manufacturer's name.
 - 4. Preformed Pipe Insulation: Type I, Grade A, without factory-applied jacket with factory-applied ASJ with factory-applied ASJ-SSL.
 - 5. 850 deg F.
 - 6. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
 - 7. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.02 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.

2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
- C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.04 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.

2.06 LAGGING ADHESIVES

- A. Adhesives shall comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

2.07 SEALANTS

- A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

2.08 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 8. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
 - 9. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
 - 10. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.09 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 11. Adhesive: As recommended by jacket material manufacturer.
 - 12. Color: White Color-code jackets based on system. Color as selected by Architect.
 - 13. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- D. Metal Jacket:
 - 1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

2.10 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
 - 2. Width: 3 inches.
 - 3. Thickness: 6.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- E. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
- F. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 - 1. Width: 2 inches.
 - 2. Thickness: 3.7 mils.
 - 3. Adhesion: 100 ounces force/inch in width.
 - 4. Elongation: 5 percent.
 - 5. Tensile Strength: 34 lbf/inch in width.

2.11 SECUREMENTS

- A. Bands:
 - 6. Stainless Steel: ASTM A240/A240M, Type 304 Type 316; 0.015 inch thick, 1/2 inch 3/4 inch wide with wing seal or closed seal.
 - 7. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch 3/4 inch wide with wing seal or closed seal.

2.12 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 - 8. Manufacturers: Subject to compliance with requirements, [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Buckaroos, Inc.
 - b. Just Manufacturing.
 - c. McGuire Manufacturing.
 - d. MVG Molded Products.
 - e. Plumberex Specialty Products, Inc.
 - f. Truebro.
 - g. Zurn Industries, LLC.
 - h. Insert manufacturer's name.
 - 9. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - a. Verify that systems to be insulated have been tested and are free of defects.
 - b. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. 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.

- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. 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 in similar fashion to butt joints.

3.04 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.

3.05 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.

3.06 FIELD QUALITY CONTROL

- A. All insulation applications will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

- a. NPS 1-1/2 and Smaller: Insulation shall be one of the following:
 - i. Flexible Elastomeric: 1/2 inch thick.
 - ii. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
- b. PVC jacketing on exposed piping

G. Domestic Hot and Recirculated Hot Water:

- 1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- 2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1-1/2 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
- 3. PVC jacketing on all exposed piping.

END OF SECTION

SECTION 22 11 16
DOMESTIC WATER PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Copper tube and fittings.
 - 2. Piping joining materials.
 - 3. Transition fittings.
 - 4. Dielectric fittings.

1.03 ACTION SUBMITTALS

- A. Product Data:
 - 1. Pipe and tube.
 - 2. Fittings.
 - 3. Joining materials.
 - 4. Transition fittings.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. System purging and disinfecting activities report.
- C. Field quality-control reports.

1.05 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not interrupt water service without Owner's written permission.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

- A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

2.02 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B88, Type K and.
- B. Annealed-Temper Copper Tube: ASTM B88, Type K ASTM B88, Type L ASTM B88, Type M.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- G. Wrought Copper Unions: ASME B16.22.
- H. Copper-Tube, Mechanically Formed Tee Fitting: For forming T-branch on copper water tube.

2.03 PIPING JOINING MATERIALS

- A. Solder Filler Metals: ASTM B32, lead-free alloys.
- B. Flux: ASTM B813, water flushable.
- C. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.04 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Cascade Waterworks Mfg. Co.
- b. Dresser, Inc.
- c. Ford Meter Box Company, Inc. (The).
- d. Jay R. Smith Mfg Co; a division of Morris Group International.
- e. JCM Industries, Inc.
- f. Romac Industries, Inc.
- g. Smith-Blair, Inc.
- h. Viking Johnson.
- i. Insert manufacturer's name.

2.05 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- i.A.Y. McDonald Mfg. Co.
- ii.Capitol Manufacturing Company.
- iii.Central Plastics Company.
- iv.HART Industrial Unions, LLC.
- v.Jomar Valve.
- vi.Matco-Norca.
- vii.WATTS.
- viii.Wilkins.
- ix.Zurn Industries, LLC.
- x.Insert manufacturer's name.

C. Dielectric Flanges:

- 1.Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Capitol Manufacturing Company.
- b. Central Plastics Company.
- c. Matco-Norca.
- d. WATTS.
- e. Wilkins.
- f. Zurn Industries, LLC.
- g. Insert manufacturer's name.

1. Standard: ASSE 1079.
2. Factory-fabricated, bolted, companion-flange assembly.
3. Pressure Rating: 125 psig minimum at 180 deg F 150 psig 175 psig 300 psig Insert value.
4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

Advance Products & Systems, Inc.
Calpico, Inc.
Central Plastics Company.
Pipeline Seal and Insulator, Inc.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

Elster Perfection Corporation.
Grinnell G-Fire by Johnson Controls Company.
Matco-Norca.
Precision Plumbing Products.
Sioux Chief Manufacturing Company, Inc.
Victaulic Company.
Insert manufacturer's name.

2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 EXECUTION

3.01 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Aboveground domestic water piping, shall be one of the following:
 1. Drawn-temper copper tube, ASTM B88, Type L ASTM B88, Type M; wrought-copper, solder-joint fittings; and brazed or soldered joints.

3.02 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- D. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- F. 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.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- H. Install piping to permit valve servicing.
- I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- M. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."
- N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- O. Install sleeve seals for piping penetrations of concrete walls and slabs.
- P. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.03 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. 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:
 - a. Apply appropriate tape or thread compound to external pipe threads.

- b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
- G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- J. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.04 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - a. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 - b. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings unions.

3.05 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings: Use dielectric nipples unions.

3.06 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

- B. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- C. Install hangers for copper, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting.
- E. Support vertical runs of copper to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.07 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - a. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - b. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - c. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection.

3.08 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.09 ADJUSTING

- A. Perform the following adjustments before operation:
 1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

- c. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
- d. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
- e. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
- f. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

- 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
- 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

- a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
- b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
- d. Repeat procedures if biological examination shows contamination.
- e. Submit water samples in sterile bottles to authorities having jurisdiction.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings.
 - 3. Galvanized-steel pipe and fittings.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Field quality-control reports.

1.04 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 4. Notify Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
 - 5. Do not proceed with interruption of sanitary waste service without Owner's written permission.

1.05 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

6. Soil, Waste, and Vent Piping: 10-foot head of water.

2.02 PIPING MATERIALS

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

2.03 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AB & I Foundry; a part of the McWane family of companies.
2. Charlotte Pipe and Foundry Company.
3. NewAge Casting.
4. Tyler Pipe; a part of McWane family of companies.
5. Insert manufacturer's name.

- B. Pipe and Fittings: ASTM A 888 or CISPI 301.

- C. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. ANACO-Husky.
- b. Charlotte Pipe and Foundry Company.
- c. Dallas Specialty & Mfg. Co.
- d. Fernco Inc.
- e. Josam Company.
- f. Matco-Norca.
- g. MIFAB, Inc.
- h. Mission Rubber Company, LLC; a division of MCP Industries.
- i. NewAge Casting.
- j. Stant.
- k. Tyler Pipe; a subsidiary of McWane Inc.
- l. Insert manufacturer's name.

2. Standards: ASTM C 1277 and CISPI 310.

3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

- D. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Charlotte Pipe and Foundry Company.
- b. MG Piping Products Company.
- c. Insert manufacturer's name.

2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.04 PVC PIPE AND FITTINGS

- A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- C. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
- D. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- E. Adhesive Primer: ASTM F 656.

PART 3 EXECUTION

3.01 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.02 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 - a. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 - b. 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. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - a. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - b. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - i. Straight tees, elbows, and crosses may be used on vent lines.
 - c. Do not change direction of flow more than 90 degrees.
 - d. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - i. Reducing size of waste piping in direction of flow is prohibited.
- K. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
 - a. Building Sanitary Waste: 2 percent downward in direction of flow for piping.
 - b. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
 - c. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- M. Install steel piping according to applicable plumbing code.
- N. Install aboveground ABS piping according to ASTM D 2661.
- O. Install aboveground PVC piping according to ASTM D 2665.
- P. Install force mains at elevations indicated.
- Q. Plumbing Specialties:
 - a. Install backwater valves in sanitary waster gravity-flow piping.
 - i. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 - b. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - i. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
 - ii. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 - c. Install drains in sanitary waste gravity-flow piping.

- i. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors.
 - a. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs.
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.03 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
 - a. Cut threads full and clean using sharp dies.
 - b. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - i. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - ii. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - iii. Do not use pipe sections that have cracked or open welds.
- D. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - b. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
 - c. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

3.04 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - a. Install transition couplings at joints of piping with small differences in ODs.
 - b. In Waste Drainage Piping: Unshielded Shielded, nonpressure transition couplings.
- B. Dielectric Fittings:

- a. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.05 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers for ABS PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- C. Support vertical runs of steel stainless-steel copper soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support vertical runs of ABS PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.06 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
 - a. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 - b. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - c. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - d. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
- D. Connect force-main piping to the following:
 - a. Elevator Sump Pump: To pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Make connections according to the following unless otherwise indicated:
 - a. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.07 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.

3.08 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - a. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - i. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - b. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - i. Expose work that was covered or concealed before it was tested.
 - c. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - i. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
 - ii. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - iii. Inspect joints for leaks.
 - d. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
 - i. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
 - ii. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - iii. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - iv. Inspect plumbing fixture connections for gas and water leaks.
 - e. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - f. Prepare reports for tests and required corrective action.

- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - a. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
 - i. Expose work that was covered or concealed before it was tested.
 - b. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
 - i. Isolate test source and allow to stand for four hours.
 - ii. Leaks and loss in test pressure constitute defects that must be repaired.
 - c. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - d. Prepare reports for tests and required corrective action.

3.09 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed ABS PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

- A. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
 - a. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
- B. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
 - a. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty hubless-piping couplings; and coupled joints.
 - b. Solid-wall Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION

SECTION 23 0000
COMMON WORK RESULTS FOR MECHANICAL

PART 1 – GENERAL

1.01 APPLICABLE REQUIREMENTS

- A. All work to be furnished and installed under this section shall comply with Division 01 – General Requirements when available. If not available, the Contractor shall meet the requirements of these specifications.
- B. Where the Owner-Contractor Agreement contradicts this division, the more stringent shall apply.

1.02 RELATED REQUIREMENTS

- A. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, including state/local building code, mechanical code, plumbing code, electrical code, fire code, and energy code.

1.03 GENERAL

- A. Work included in 23 00 00 applies to Division 23 work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of mechanical systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications, Drawings, Addenda, Owner/ Engineer Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. In the event there is a discrepancy between the drawings, specifications and current code, the more stringent shall apply.
- D. Examine the Drawings, specifications and other Contract Documents relating to the Work and the work of all trades and become fully informed as to the extent and character of work required. Coordinate all work with that of others to ensure proper and complete installation of all materials, equipment and supports.
- E. Intent:
 - 1. The intent of the Contract Documents is for the Contractor to include all work necessary for the complete systems, tested and ready for operation (hereinafter "Design Intent").
 - 2. Provide all items not specifically shown on the drawings, called for in the specifications or related Contract Documents, but required to conform to the labor, material and equipment to achieve the Design Intent.
 - 3. Provide all scaffolding, access provisions, tools, appliances, consumables, fees, permits and licenses, debris removal/disposal, supervision and labor, including required start-up, check-out and training to provide complete and fully operable systems in full compliance with the Contract Documents.
 - 4. Before submitting a bid and prior to the start of work, Contractor shall examine all conditions relating to the Work, including that associated with the work of other trades upon which Contractor's work may rely or otherwise depend, to achieve the Design Intent, in accordance with the best trade practices, workmanship and highest quality product installation, taking into account the sequence of the work, delivery, storage and hoisting requirements, requirements for access, testing and temporary services and all other site limitations and project complexities. Report to the Architect/Engineer any

conditions which might prevent installation of materials and/or equipment in the manner intended by the Contract Documents or contrary to applicable codes, standards or regulations.

5. By submitting a bid, the Contractor represents that it has made a thorough examination of the site, of the work, including that associated with the work of other trades, all existing conditions and limitations, and that it has examined the Contract Documents in complete detail and has determined beyond doubt that the drawings, specifications, and existing conditions are sufficient, adequate and satisfactory for the construction of the work under the Contract.
 6. No consideration or allowance will be granted for any alleged misunderstanding of materials, equipment or components to be furnished or work to be done; it being agreed that tender of proposal carries with it agreement to items, terms and conditions required by the Contract Documents.
 7. Where minor adjustments of the work are necessary for purposes of fabrication or installation of items, or resolution of conflicts between items within the intent of the Contract Documents, the Contractor shall make such adjustments with no added compensation. Where such adjustments affect functional or aesthetic design of the work, they shall first be submitted to the Architect for review and approval.
- F. Site Visit:
1. Contractor shall visit the site and verify the exact conditions relating to the work and obtain such information as may be necessary to present a complete and comprehensive bid. No allowance will be made for any extra expense due to Contractor's failure to make such a visit and reasonably verify all actual/existing conditions. In the event of a conflict between existing conditions and the requirements of the Contract Documents, perform the necessary work to conform to Design Intent. The Owner or his representative will be the sole individual to interpret the intent of the Drawings in the event of a conflict between (1) existing conditions and those shown on the drawings, or (2) quality of existing material and quality of material indicated on the drawings or in the specifications. Wherever a conflict such as this occurs, the higher standard shall prevail.
- G. Conditions:
1. Conform to all Bidding Requirements and General Conditions
 2. The Contractor is obligated to comply with the above in addition to the requirements of this Section.
 3. Modifications by this Section do not nullify any other portions of the above-referenced conditions.
- H. Make complete system installation, connecting to all equipment shown on the plans, or called for in the specifications. Contractor to provide any additional extra valves not shown on plans to obtain design criteria as required for a complete system and by the balancing contractor.
- I. Drawings:
1. Drawings do not attempt to show all aspects of building construction, which will affect the installation of the systems. The drawings are diagrammatic and do not intend to show all offsets and fittings that may be required for a complete installation. Locations of equipment, pipes, valves, traps, ductwork, etc. shown on the drawings, shall be followed as closely as conditions will permit. Review all project drawings, including, but not limited to, architectural, structural, plumbing and electrical drawings; and coordinate with all trades involved so there is no conflict with work of other trades and so Owner secures best arrangement of work consistent with use of space.

2. Verify exact distances between points shown on drawings by actual measurement at site, as no extra cost will be allowed for differences between actual measurements and scaled measurements on drawings.
3. Changes in design, configuration, or location of equipment, piping, or ductwork, advisable in the opinion of Contractor, shall be submitted to Architect/Engineer for approval before proceeding with work, with written assurance from other trades that such changes will not interfere with their installation, nor cause any extra cost on their part. Such changes shall be made at no additional cost to Owner.
4. Check location of all work of all trades and avoid interferences. Conflicts shall be reported to Architect/Engineer for decision and direction. Special attention is called to the following items:
 - a. Exact location of outlets shown on architectural details.
 - b. Location of suspended ceilings.

1.04 SPECIAL REQUIREMENTS

- A. When applicable, Contractor acknowledges the ongoing operations of the Owner at or in close proximity to the Project and agrees to coordinate the timing of the Work with the Owner's ongoing operations; perform the Work in a manner that minimizes or eliminates and adverse impact upon the Owner's ongoing operations; confine operations at the site to areas approved by Owner, permitted by law, permits and the Contract Documents; comply with the Owner's standard security, health and safety policies and procedures; not unreasonably encumber the site with any materials or equipment; and not place signs or advertising on or about the site without prior approval of Owner.
- B. Where applicable, all seismic construction, restraints, bracing, mounts and hanging systems shall be in full compliance with the requirements of all Authorities Having Jurisdiction (AHJ's), pre-approval, certification and engineering (including certified engineering calculations and stamps). Contractor shall be solely responsible for obtaining and complying with all requirements of the AHJ.

1.05 DEFINITIONS AND ABBREVIATIONS

- A. Finished Spaces: Spaces other than mechanical, plumbing and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical, electrical and plumbing equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include spaces above hard or lay-in type ceilings and in duct shafts.
- E. 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.
- F. The word "provide," means "furnish and install."
- G. The word "approved," means acceptance by the Architect or Engineer
- H. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the drawings, or other paragraphs or schedules in the specifications, and similar requirements

in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the reader locate the reference. Location is not limited.

- I. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted," mean directed by the Architect/Engineer, requested by the Architect/Engineer, and similar phrases.

1.06 REFERENCE STANDARDS AND GUIDELINES

A. Include but are not limited to the latest adopted editions from:

1. ADA Americans with Disabilities Act
2. AHRI Air-Conditioning Heating & Refrigeration Institute
3. AMCA Air Moving and Conditioning Association
4. ANSI American National Standards Institute
5. ARI Air Conditioning and Refrigeration Institute
6. ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers
7. ASME American Society of Mechanical Engineers
8. ASPE American Society of Plumbing Engineers
9. ASSE American Society of Sanitary Engineering
10. ASTM American Society of Testing Materials
11. AWWA American Water Works Association
12. AWS American Welding Society
13. CFR Code of Federal Regulations
14. CISPI Cast Iron Soil Pipe Institute
15. EPA Environmental Protection Agency
16. FM Factory Mutual Engineering Corporation
17. GAMA Gas Appliance Manufacturers Association
18. IAPMO International Association of Plumbing & Mechanical Officials
19. ISO International Organization for Standardization
20. MSS Manufacturers Standardization Society
21. NEBB National Environmental Balancing Bureau
22. NEC National Electric Code
23. NEMA National Electrical Manufacturers Association
24. NFPA National Fire Protection Association
25. OSHA Occupational Safety and Health Administration
26. SMACNA Sheet Metal and Air Conditioning Contractors National Association, Inc.
27. UL Underwriters Laboratories

1.07 SCOPE

- A. The work includes, but is not necessarily limited to, the furnishing of all labor, materials, equipment, tools, appliances, hoisting, scaffolding, supervision, for the proper execution and completion of the mechanical work and services necessary for, and reasonably

incidental to, providing and installing complete mechanical systems and other work as shown or indicated in the Drawings and Specifications.

- B. The contractor is responsible for a complete and operational system installation. Contractor shall provide all necessary components for a complete and operational system even if such components are not specified or shown in the drawings or specifications. The contractor shall notify the Architect/Engineer of such mission for resolution prior to system installation. All new equipment and products as noted in Part 2 of each section shall be installed as per manufacturer's recommendations.
- C. Provide all additional piping, caps, and valves not shown on drawings, to maintain fully operational systems during the project at no additional cost to the owner.
- D. Consult all other Sections to determine the extent and character of this work specified elsewhere.
- E. Make all connections to equipment requiring service from systems installed under this Section.

1.08 SUBMITTALS

- A. Reference Division 1 for submittal requirements when available. If not available, the contractor shall meet the requirements of these specifications.
- B. General
 - 1. Review is for general conformance with the Contract Documents and is not intended to otherwise approve or verify dimensions, quantities, or to coordinate the Work shown on shop drawings on or between Contractor and the work of other trades or Sections. Contractor is solely responsible for quantities, dimensions, means and methods. Dimensions shall be confirmed and correlated by Contractor at the jobsite prior to the start of the Work (procurement, fabrication, construction or other commencement activities). Contractor's failure to fully verify conditions at the jobsite prior to commencement of the work shall not relieve Contractor of its obligations under the Contract Documents and Contractor shall be responsible for all damages caused by or related to its failure to comply with the requirements of this provision.
 - 2. Submittal review shall be performed to show compliance with the design intent. Contractor shall specifically note any deviations from the Contract Documents and explain the reason and nature of the deviation. Such deviations will be reviewed or rejected on the submittal. Deviations not so identified shall not relieve the Contractor from the requirements of the Contract Documents.
 - 3. Resubmittals will be reviewed for compliance with comment(s) made on the original submittal only. Architect/Engineer shall not be responsible for changes made upon resubmittal that are not clearly identified (highlighted), and responsive directly to the initial rejection. Resubmittals should not be packaged with non-related first-time submittals, all resubmittals must be marked with the resubmittal number and date and must otherwise comply with all submittal requirements.
 - 4. Submit shop drawings, commissioning plan(s) and checklists, penetration locations, supplemental data, etc. as may be required by the Contract Documents for all materials, equipment and other components of the work included in all Sections of this Division and other provisions of the Contract Documents in accordance with the requirements of this Division and referenced sections.
 - 5. All submittals must be reviewed by Contractor, and bear Contractors review stamp and signoff for Conformity to the Contract Documents, prior to the submission of any required submittal to Architect/Engineer. Submittals that fail to meet this requirement will be considered incomplete, will not be reviewed by Architect/Engineer and will be

returned to Contractor, without review and/or rejected and resubmittal will be required. Contractor shall be solely responsible for any and all Additional Review Costs and/or other project costs or schedule impact.

6. Forward all submittals to Architect/Engineer in a coherent, organized fashion, complete and packaged as required herein, Architect/Engineer may reject submittals that fail to comply with this or any other provision of the Contract Documents and Contractor shall be solely responsible for any and all Additional Review Costs and/or other project costs or schedule impact.
 7. Subject to other provisions of the Contract Documents and in the absence of a more stringent requirement, Architect/Engineer will review a submittal not more than two (2) times. If a submittal is required to be reviewed more than twice due to incomplete, or incorrect information the contractor shall be solely responsible for any and all Additional Review Costs and/or other project costs or schedule impact.
 8. Identify each submittal item by reference to Specification Section paragraph in which item is specified, or drawing/detail number, as applicable. In addition, for equipment submittals, include identification numbers appearing on the equipment schedule.
 9. Identify each item by manufacturer, brand, trade name, number, size, rating, or whatever other data is necessary to properly identify and check materials and equipment. Words "as specified" are not sufficient identification.
 10. Organize submittals in same sequence as they appear in specification sections, articles or paragraphs.
 11. All materials and equipment submittals shall have a summary sheet at the front complete with catalog numbers. Where materials or equipment pertain to more than one building, submittals shall clearly indicate at which locations the materials or equipment is to be installed.
 12. Submittals shall show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping and/or conduit entrance, access requirements for installation and maintenance, physical size and dimension, electrical characteristics and requirements, foundation/curbs and all permanent and temporary support details as well as all information relating to weight, including but not limited to live and dead weights and other information necessary for component verification and coordination with other trades.
- C. Submittal Schedule – Provide a detailed submittal schedule including all requirements of this Division and its subdivisions to the Architect and Engineer within thirty (30) days of contract award.
1. Contractor shall submit for the Engineer's approval a Submittal Schedule for the performance of the work that is consistent with the requirements of the project schedule. The Submittal Schedule shall allow reasonable time for the Architect and other consultants review. If the time for Architects/Engineers review is not otherwise specified, the review period (from date of receipt) shall be a minimum of ten (10) business days. Once approved by the Architect/Engineer, submittal dates and time limits established by the Submittal Schedule shall not, except for reasonable cause, be changed or exceeded by the Contractor.
 2. For each submittal required by the Contract Documents, the schedule shall include: specification section number, subsection/paragraph identification number, item description (as stated in the applicable specification section, subsection or other Contract Document) and the scheduled delivery date to the Architect/Engineer.

3. Contractor shall be responsible to the Architect/Engineer and/or Owner for all costs, expenses and impact to the project schedule resulting from any deviation to the approved Submittal Schedule, including but not limited to: payment for required overtime, out-of-house resources/consultants or other higher cost resources of the Architect/Engineer as may be required to perform out of sequence, stacked, critical, delayed, unscheduled or multiple reviews of required submittals necessitated by rejection of a prior submittal, (cumulatively and hereinafter, "Additional Review Costs")
- D. Catalog Cuts & Submittal Literature
1. Catalog cuts, submittal literature and published material may be included to supplement scale drawings provided that the actual make and model of equipment being submitted on is identified.
 2. Submittal literature, drawings and diagrams shall be specifically applicable to this project and shall not contain extraneous material or optional choices. Clearly mark literature to indicate the proposed item.
- E. Shop Drawings:
1. Shop drawings shall include all significant systems, equipment and components, including but not limited to all equipment, devices, connections and elevations. Include all related specialty rooms (i.e. mechanical, electrical, data/technology). Drawings shall be at a minimum scale of 1/4" per 1'-0" and shall be fully coordinated with the work of other trades and/or sections.
 2. Identify congested areas and clearly indicate solutions to space problems, developed in conjunction with the work of other trades and/or Sections. Identification of space problems without proposed solutions is not acceptable and is grounds for rejection. For such areas indicate, superimposed, the work of all trades and/or Sections involved and:
 - a. Clearly identify each area of congestion and deviations from the Contract Documents, and:
 - b. Proposed solution(s), clearly documented and signed-off by all other trades and/or Sections involved.
- F. Anchorage and Supports: Submit details and calculations for support and anchors that are not specifically detailed on the drawings. All calculations must meet current seismic and structural code.
1. Provide details and calculations for equipment per local adopted building codes:
 - a. Having an operating weight over 400 pounds or more and mounted directly to the floor.
 - b. Having an operating weight over 20 pounds and suspended from the roof, floor, or wall or supported by vibration isolation devices.
 2. Where pre-approved bracing systems will be employed, submit:
 - a. System component brochure describing components used and detailed installation instructions.
 - b. Loads to be transmitted to the structure at anchor points.
 3. Where anchorage, support, and bracing are not detailed on the drawings, and pre-approved systems are not used, submit details and calculations of proposed systems. Include:
 - a. Anchorage and Supports

- 1) Where equipment substitutions change the weight, size, configuration, or other aspects of systems and equipment that will affect the performance of anchorages and/or supports, submit calculations for proposed anchors and supports, and install them as shown in these calculations.
 - 2) Where substitutions will have no effect on anchors and supports detailed on Contract Documents, submit information on sizes, weights, center of gravity and other relevant information to demonstrate this fact.
- G. Shop Fabrication Drawings: Drawings are for the Contractor's use and shall be its responsibility. Do not submit shop fabrication documents unless specifically requested.
- H. Testing: Coordinate Shop Drawings to include any additional components for proper system testing.
- I. Certificates: Submit final inspection certificates signed by governing authorities.
- J. Operating and Maintenance Instructions and Manuals.
1. Three (3) complete sets of instructions containing the manufacturer's operating and maintenance instructions for each piece of equipment shall be furnished to the Owner within ninety (90) days of issuance of final occupancy permit. Each set shall be electronic or permanently bound with a hard cover. The following identification shall be inscribed on the covers, "OPERATING AND MAINTENANCE INSTRUCTIONS", the name and location of the building, the name of the Contractor, and the Contract number. Flysheets shall be placed before instructions covering each subject. The instruction sheets shall be approximately 8 1/2" x 11" with large sheets of Drawings folded in.
 2. Instructions on major items, including but not limited to: switchgear, generators, pumps, air compressors, boilers, specialty units, fans, air handlers, AC units and temperature controls, shall be by representative of manufacturer of respective equipment.
 3. Submit as identified below and as noted in other specification references.
 - a. Names, addresses and phone numbers of contractors and subcontractors. List of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
 - b. Complete operating and maintenance instructions and parts lists of all equipment and component parts. Data sheets to show all connections, ratings, characteristics, wiring connections, catalog data on component parts whether furnished by equipment manufacturer or others, names, addresses and telephone numbers of source of supply for parts subject to wear or failure, and description of operating, test, adjustment, and maintenance procedures.
 - 1) Where data sheets included in manual cover equipment, options, or other features not part of equipment actually furnished, line out these references or otherwise clearly mark so remaining text, diagrams, drawings, schedules, and similar information shall apply specifically to equipment furnished.
 - c. Operating Instructions should include, but not be limited to:
 - 1) Normal starting, operational and shutdown procedures, including emergency procedures for each type of equipment/system.
 - 2) Equipment wiring and control diagrams.
 - 3) All other items as may be specified/required by this Section and the Contract Documents.

- d. Maintenance Instructions
 - 1) All items as may be specified/required by this Section and the Contract Documents.
 - e. Manufacturers Data (each piece of equipment)
 - 1) Installation instructions
 - 2) Drawings & specifications
 - 3) Parts List, including recommended stock and long lead parts/components.
 - 4) Wiring and riser diagrams.
 - 5) Warranties and guarantees for all equipment, materials and components, including repair, replacement and labor from both Contractor and manufacturer as required by the Contract Documents.
 - 6) Certificates of Installation – manufacturer’s certification of supervision during equipment installation and start-up procedures.
 - 7) All other items as may be specified/required by this Section and the Contract Documents.
- K. Record Documents.
- 1. Maintain one (1) complete set of prints and specifications at the job site exclusively for recording deviations from the drawings which are necessary because of job conditions, request for information and/or approved change orders. Record locations and depths of buried and concealed system components from fixed, easily identifiable objects, such as building walls or other fixed physical objects. Where systems are concealed in walls or other fixed physical objects, indicate distances from building corners or other building features not likely to be disturbed by fixture alterations.
 - 2. Submit Record Drawings within 90 days of system acceptance by owner.
- L. Drawings, specifications (as-builts) and approved submittals.
- 1. Where the project uses a BIM model the contractor shall keep the model updated in a similar fashion, maintaining the current project record as described above and submit, in addition to all other requirements of this Section and other provisions of the Contract Documents a complete and accurate BIM model for the project.
 - 2. Prior to Substantial Completion, obtain from the Architect a complete set of printed drawings at the Contractor’s cost. Record all revisions to these drawings to indicate as-built conditions. Indicate all changes, including RFI’s, on this set of documents. Submit one set of blueprints of these revised drawings for review. Make necessary changes and deliver to Architect one set of electronic documents, including any BIM model, upon Final Completion and Acceptance.
 - 3. All test reports, certifications, and inspection reports.
 - 4. AHJ/Specialty AHJ Approvals (i.e. Fire Marshal and/or Fire Department system approvals).
 - 5. Substantial and Final inspection certificate signed by governing authorities.
 - 6. All other items as may be specified/required by this Section and/or other provisions of the Contract Documents.

1.09 EQUIPMENT DEVIATIONS AND SUBSTITUTIONS

- A. Substitutions will only be considered after project award. No substitutions will be considered during bid and/or negotiation periods.

- B. No substitutions will be allowed and/or considered unless the description of a product includes the phrase "approved equal" and then only upon a determination as to equivalency and impact upon the project budget, schedule and the work of others, including any redesign of the project or its system components by the Architect, Engineer or other trades. The final determination as to sufficiency or acceptance of any such substitution and/or deviation properly requested and submitted by Contractor will lie solely with the Architect/Engineer. Contractor may not implement substitutions that have not been approved by Architect/Engineer.
- C. Unless specified elsewhere in the Contract Documents, a minimum of two (2) weeks shall be allowed for evaluation of any substitution. The burden of all systems re-engineering/design, testing, suitability and constructability is solely placed upon the Contractor for all deviations from the basis of design as reflected in the Contract Documents.
- D. If approved by Architect/Engineer, all such redesign, including all new drawings and detailing required, will be prepared by the Architect/Engineer and their sub-consultants for Change Order documentation for approval by Owner and the Authority Having Jurisdiction will be paid by the Contractor as part of the Deviation Review Costs.
- E. When the Engineer approves a substitution, the approval is given with the understanding that the Contractor guarantees the article or material substituted to be equal to or better in every respect than the article or material specified. The Contractor shall also assume complete responsibility that the article or material will fit the job as far as space, access, and servicing requirements.
- F. Where several materials are specified by name for one use, select for use any of those so specified subject to compliance with specified requirements.
- G. Whenever item or class of material is specified exclusively by detail specification, trade name, manufacturer's name or by catalog reference, use only such item, unless written approval is given. Submit written requests in accordance with these and referenced specifications.
- H. Make no substitutions for materials, articles or process required under contract unless written approval is obtained.

1.10 COORDINATION

- A. Prior to construction, coordinate installation and location of systems, devices and equipment with architectural and structural requirements, and other trades (including ceiling suspension, and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Drawings and corresponding electronic media are diagrammatic and indicate the general arrangement of systems and work included in the Work. Consult the drawings, details and other electronic media for locations of fixtures and equipment; where same are not definitely located, obtain this information from the Architect/Engineer.
- C. Take all dimensions from Architectural and Structural Drawings, certified equipment drawings and from the actual field measurements before fabricating work. All conflicts shall immediately be reported to the Architect/Engineer. Contractor is solely responsible for conflicts known or which reasonably should have been know but not reported or resolved before commencement of the work

- D. Coordinate connection of systems with interior/exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- E. Before submitting a bid for the work the Contractor shall visit the site and become familiar with all the work on other related Drawings and Specifications, and plan the work to provide the best possible assembly of the combined work of all trades. No additional costs will be considered for work which has to be relocated due to conflicts with other trades.
- F. If, after examination of the bidding documents relating to the work, the Contractor has queries concerning the nature and scope of the work or intent of the Specifications, he/she shall promptly request clarification from the Architect/Engineer. After contract award, claims of ignorance of the intent and scope of the contract shall not be allowed.
- G. Contractor is responsible for coordinating the schedule of inspections by Engineer at appropriate stages of construction such as rough-in, pre-final, and final, and at other times required by the Specifications or by the construction. Notify Architect and Engineer seven (7) days in advance of proposed site visit. Notification constitutes certification that construction is, or will be, complete and ready for observation. In the event that construction is not ready for observation, contractor shall bear the cost of additional site visits.

1.11 COORDINATION DRAWINGS

- A. Detail major elements, components, systems, equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
 1. Planned system distribution layout, including specialty device locations and access for operation
 2. Clearances for installing and maintaining insulation.
 3. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
 4. Equipment and accessory service connections and support details.
 5. Other systems installed in same space.
 6. Exterior wall and foundation penetrations.
 7. Fire-rated wall and floor penetrations.
 8. Ceiling and wall-mounted access doors and panels required to provide access to operating devices or items needing access for proper maintenance
 9. Sizes and location of required concrete pads and bases.
 10. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
 11. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

1.12 SEQUENCING AND SCHEDULING

- A. Coordinate equipment installation with other building components.
- B. Arrange for space, chases, slots, and openings in building structure during progress of construction to allow for distribution system installations.
- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

- D. Sequence, coordinate, and integrate installations of all materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Some equipment may require temporary installation during one phase and require relocation to final location under another phase. Provide all associated labor and materials to accommodate this phasing.
- F. Coordinate connection of all systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate requirements for access panels and doors if items requiring access are concealed behind finished surfaces. Access panels and doors will be required.

1.13 ACCESSIBILITY

- A. Contractor is responsible for verifying that equipment and devices will fit within the space shown on the drawings. Contractor shall locate all equipment which must be serviced, operated or maintained, in fully accessible locations.
- B. Minor deviations from the drawings may be made to allow for better accessibility, but changes of magnitude or which involve extra cost shall not be made without approval from the Architect/Engineer.

1.14 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed shall conform with all local, State, Federal and other applicable laws and regulations.
- B. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- C. Installer Qualifications: Company specializing in performing the work of this section. Company personnel shall be approved by manufacturer for all product installations and required training.
- D. Conform to all applicable standards, codes and regulation and industry best practice requirements.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. All materials and equipment shall be new, shall bear manufacturer's name, and shall conform to the grade, quality and standards specified herein. Type, capacity and application shall be suitable and capable of satisfactory operation for the purpose intended. All equipment and components shall include UL label and/or marking on equipment body/device including manufacturer's name, pressure rating(s), electrical classification(s), limits and ratings as applicable to individual components for the purpose specified and intended.
- G. Equipment Selection: Equipment allowed by the specifications but with different electrical characteristics, physical dimensions, capacities, and/or ratings than what is shown on the Drawings may be furnished, provided such proposed equipment is approved in writing and connecting mechanical and electrical services, such as pipe and/or duct connection sizes, circuit breakers, conduit, motors, bases, and equipment spaces are revised to accommodate such equipment. Maintain a minimum duct length of three straight diameters at all fan inlets and outlets. All expenses shall be borne by the Contractor. Specified minimum energy ratings and/or equipment efficiencies must meet design and commissioning requirements.

- H. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.
- I. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.
- J. Listing and labeling: Provide motors that are listed and labeled. Terms "listed and labeled": as defined by UL, NEC, Article 100 or other applicable recognized agency as specified in the Contract Documents.
- K. Cutting & Patching: Unless otherwise required by the Contract Documents, Contractor shall be responsible for all cutting, fitting and patching required to complete the Work, or to make portions of the Work and existing conditions fit together properly, and all such areas shall be restored to the conditions existing prior to the cutting, fitting and patching unless otherwise provided in the Contract Documents
- L. Lead Free Requirements: Contractor shall endeavor to use lead free products and where required by law, ordinance, regulation or standard all materials products and practices shall comply with limitations and requirements as to the allowable limits and/or percentages of lead. Lead free products must be certified by and independent 3rd party.
 - 1. This provision shall apply to any and all similarly regulated materials, products and practices that may be considered hazardous or are otherwise regulated by applicable law, ordinance regulation or standard in the project local.

1.15 DELIVERY, STORAGE, AND HANDLING

- A. All materials and equipment shall be adequately covered and protected against dirt, water, chemical or mechanical damage, and theft. At completion, all work, equipment and materials shall be cleaned, and damage repaired by Contractor. Damaged equipment will be replaced by the contractor if Owner does not accept repairs done to the equipment. Such replacement shall be scheduled to minimize building system interruption of occupied or scheduled for occupancy.
- B. Material delivered at the site shall not be left exposed to the weather or left unattended. Deliver pipes, tubes and conduit with factory-applied end-caps. Contractor shall be responsible to maintain end-caps or provide temporary end caps on all open-ended piping, tubes and conduit through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- C. Protect bright finished shafts, bearing housings and similar items until in service.
- D. Protect plastic pipes and materials from sunlight and support to prevent sagging and bending.
- E. Elevate stored materials above grade. When stored inside, do not exceed structural capacity of the floor.
- F. Provide protective coatings to materials to prevent damage and/or infiltration of moisture and dirt on all materials and equipment including but not limited to cast iron and steel valves.
- G. Contractor shall check the openings in the building and the size of the doors, passages, and openings through which equipment is to be admitted. Wherever necessary, he shall provide the equipment in sections or knocked down in order to admit the equipment through these openings.
- H. Contractor shall provide all rigging, erection and hoisting equipment as required to handle or place equipment and piping in position. This rigging and hoisting equipment shall only be

attached and placed on the structure in locations as approved by Architect/Engineer at the site.

1.16 PERMITS AND FEES

- A. Contractor shall arrange and pay for all permits, fees, and inspections required to perform the Work. The Contractor shall present the Owner with properly signed certificates of final inspection before the Work will be accepted.
- B. Contractor shall call for all inspections by local building official(s) when they become due, and shall not cover any work until approved by these governing authorities.
- C. Contractor shall make all arrangements with utility companies for water, steam, gas and drainage services, etc., associated with the work and include required payments for meters, piping, services, connection charges and materials furnished and installed by utility companies. Work and materials shall be in strict accordance with rules of respective authorities.

1.17 DOCUMENT OWNERSHIP

- A. The Drawings and Specifications, combined with the calculations, field data, notes, and reports, are the intellectual and real property of the Architect and/or Engineer. This covers all forms of written and recorded or electronic media. The reuse of these documents without specific permission of the Architect and Engineer is prohibited. The Drawings may be employed by the Owner and Contractor for the express use of constructing, commissioning and operating the facility only upon proper execution of an Agreement for Use of Electronic Files & Data.

1.18 GUARANTEE AND WARRANTY

- A. Contractor warrants to Owner that the materials and equipment provided under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects. Work, materials and equipment not conforming to these requirements, including substitutions not properly approved by Change Order, shall be considered defective. This warranty excludes remedy for damage caused by improper or insufficient maintenance, improper operation or normal wear, tear and usage. Contractor shall assign to Owner, or otherwise assure the Owner has the full benefit of, all warranties and guarantees of manufacturer, subcontractors, sub-subcontractors and suppliers, and Contractor shall perform the Work in a manner that does not adversely affect or invalidate any available warranties or guarantees.
- B. Contractor shall warrant and guarantee all work against faulty material or workmanship for a period of one (1) year from the date of final completion and written acceptance by the Owner, unless specified more stringently elsewhere in the Contract Documents.
- C. If the project is occupied or the systems placed in operation in several phases at the request of the Owner, the guarantee of each system or piece of equipment used shall begin on the date each system or piece of equipment was placed in satisfactory operation, tested, commissioned and accepted, in writing, by the Owner. The use of building equipment for temporary service and testing or phases of work completed prior to the projects final completion and acceptance by the Owner does not constitute the commencement of the warranty period.
- D. If a defect or deficiency in the Work is discovered within the one (1) year Warranty & Guarantee period or within such longer period as may be prescribed by the Laws or by any specific guarantee, and Owner elects to have Contractor correct such defect or deficiency, Owner shall notify Contractor of such defect or deficiency in writing. This period of correction relates only to the specific obligation to correct defects and deficiencies and in no

way otherwise limits the Contractor's responsibility for Work that is not in accordance with the Contract Documents, If Contractor fails to timely correct defects or deficiencies in the Work, Owner may, at its sole option, correct them and charge contractor for all cost therefore.

- E. Specific exclusions, if any, from this one (1) year warranty and guarantee period are listed in the individual specification sections.

1.19 LIMITATIONS OF LIABILITY

- A. To the extent any of the following provisions are not more stringently included in the Contract Document the following Limitations of Liability shall apply:
- B. Architect/Engineer is not responsible for Contractor's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, and is not responsible for Contractor's failure to perform or furnish the work in accordance with the Contract Documents.
- C. In the event that Architect/Engineer's employees or sub-consultants make comments or issue warnings about safety issues, such comments and warnings shall be considered to have been offered by a Good Samaritan and shall not impose any obligation or responsibility.
- D. Engineer will not be responsible for the acts or omissions of Owner, Contractor, any subcontractor, any supplier, or of any other person or organization performing or furnishing any of the portions of the work
- E. Contractor understands and acknowledges that Engineer is not authorized to order extra work or issue Change Orders to the work, however in the event and to the degree that Engineer may offer advice, suggestions, and opinions Contractor shall not rely on such advice, suggestions, and opinions unless directed in writing by Owner or its designated representative, and shall, in no event, make any claim against the Engineer for any such advice, suggestions, and opinions.
- F. To the fullest extent permitted by law, Contractor shall indemnify and hold harmless Architect, Engineer, and their joint ventures, officers, directors, partners, employees and agents from and against any and all claims, costs, loses and damages (including but not limited to all fees and charge of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) caused in whole or in part by the negligent acts or omissions of Contractor, Contractor's officers, directors, partners, employees, agents; or contractor's subcontractors or material men in the performance of Work. Contractor shall direct its insurer to list Architect, Engineer, and their joint ventures, as Additional Insureds on general liability insurance policies covering this project. Prior to commencing work, Contractor shall submit copies of its certificate of insurance to both Architect and Engineer.

1.20 SAFETY

- A. Contractors must conduct a weekly safety meeting with their employees and provide documentation as to attendance and topics of discussion. Engineer's construction support services do not constitute review or approval of Contractor's safety procedures. Contractor shall comply with all OSHA regulations. Contractor is required to obtain and pay for insurance required to cover all activities within Contractor's Scope of Work.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. See Drawings for equipment data, capabilities, and requirements. Manufacturers are identified for the purpose of establishing quality; alternative manufacturers of equal quality are acceptable. If alternative manufacturers are proposed it is the contractor's responsibility to verify and demonstrate the proposed alternative is equivalent.
- B. Provide like items from one manufacturer, including but not limited to pumps, fans, valves, control devices, air handlers, vibration isolation devices, etc.

2.2 MATERIALS

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL approved or have adequate approval or be acceptable by State, County, and City authorities. Provide all materials omitted herein but necessary to complete the work.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. All electrical materials shall bear the label of, or be listed by, the Underwriters' Laboratories (UL), unless the material is of a type for which label or listing service is not provided.
- D. Hazardous Materials: Comply with local, State of Oregon, and Federal regulations relating to hazardous materials. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

2.3 ACCESS PANELS

- A. Confirm Access Panel requirements in individual Division 23 sections. Comply with the following:
 - 1. Provide flush mounting access panels for service of systems and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly. Ceiling access panels to be minimum of 24 x 24 or as required and approved size. Wall access panels to be minimum of 12 x 12 or as required and approved size.

2.4 DRAIN PANS

- A. Provide drip pans under all hot water heaters, above-ceiling inline pumps, cooling coils and heat recovery coils. Locate pan immediately below piping and equipment, and extend a minimum of 6" on each side and lengthwise 18" beyond equipment being protected. Pans shall be 2" deep and fabricated from reinforced sheet metal (20 gauge copper or 20 gauge steel with two ounces zinc finish hot dipped after fabrication) with rolled edges and soldered or welded seams. Provide 3/4" copper drainage piping, properly discharged to floor drain, hub drain, or as shown on Drawings. Provide condensate pumps as necessary. Comply with Oregon Mechanical Specialty Code for overflow protection and pipe sizing.

2.5 GUARDS

- A. Provide guards in accordance with State Safety Code and OSHA requirements over all rotating equipment including belts, shafts and couplings. Drive guards over belts and sheaves shall include 2-1/2" diameter access opening at shaft ends for speed counter.

2.6 PENETRATION FIRE STOPPING

- A. Through-penetration fire stopping system tested and listed by Underwriters Laboratories. 3M, Metacaulk, SpecSeal, or approved equivalent.
- B. Select system for proper application based on wall construction, type of penetrating item, wall rating, etc.

2.7 MISCELLANEOUS STEEL

- A. Provide all steel as required for adequate support of all mechanical equipment. Use standard angle or channel, I or H sections as required by application. Adequately cross-braced and welded pipe stands may be used for tank supports. Provide suitable base plates for all stands and anchors for all hanging equipment. Drill or burn support holes only in flanges of structural shapes and only in one leg of any one angle, and as far from center of length as possible.
- B. Paint: Apply one coat of black Rustoleum primer to shop fabricated items before delivery to the job; other painting as specified herein.

PART 3 – EXECUTION

3.1 GENERAL MECHANICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of the mechanical systems, materials, and equipment. Comply with the following requirements:
 - 1. Coordinate systems, equipment, and materials installation with other building components.
 - 2. Verify all dimensions by field measurements.
 - 3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for system installations.
 - 4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
 - 5. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
 - 6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
 - 7. Coordinate connection of systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
 - 8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
 - 9. Install systems, materials, and equipment level and plumb, and parallel or perpendicular to other building systems and components, where installed exposed in finished spaces.
 - 10. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
 - 11. Install access panel or doors where units are concealed behind finished surfaces. Coordinate with other divisions.

12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
 13. Replace all air filters with new filters upon Owner taking occupancy of the building or at a time mutually agreed upon between the Owner and Contractor.
 14. Do not install ductwork or piping in elevator machine rooms, electrical and/or communication rooms unless it directly services that room.
- B. Locate wall, floor and ceiling fire ratings from architectural drawings for appropriate hourly rating of combination fire/smoke dampers or fire dampers shown on mechanical drawings.

3.2 CONTINUITY OF SERVICE

- A. Contractor, in the performance of the Work shall plan for and incorporate into the work the continuity of services. Where the continuity of service(s) is required to be interrupted Contractor shall plan and schedule the work to minimize interruptions to the facility and its normal operations, prearrange and coordinate all outages/interruptions with Owner's representative, utilities and the work of others. Requests for system interruptions/outages must be submitted at least (5) days prior to intended shutdown time and then subject to Owner's adjustment and/or approval.
- B. For connections that require a significant interruption to facility operations (as determined by the Owner), Contractor shall provide for Owner's written approval a detailed plan, schedule and description of the work for each system interruption. The plan shall include a description and schedule of each work item to be completed, designation of site supervisor and contact information, designated work crew as well as facility access and egress points for materials, manpower and equipment, contingency plan for parts, materials and equipment as well as a program to restore systems in the event of unplanned disruption or inability to complete the work in the timeframe scheduled and approved by Owner. Contractor shall confirm scheduled dates with the Owner and provide a minimum of five (5) days advance notice for each operation.
- C. Where possible and subject to Owners sole discretion, connections to existing systems shall be performed during normal operating conditions. Unless required otherwise (specifications, code, practice, etc.) all tap connections shall be 'live', 'wet' or 'hot"', with the proper safety programs and procedures for isolating system components to ensure the safety of the workforce, occupants and the facility.
- D. Contractor shall include all costs for overtime labor, expedited materials, equipment and contingency planning as necessary to maintain continuity of services, schedule and complete necessary connections. Contractor shall also include provisions for maintaining any and all supplemental systems that may be required to remain in service for the safety, protection and critical operations of the facility and its occupants including but not limited to: Fire Alarm, Security, Phone/Data, BAS, Emergency Power and similarly related critical or emergency systems. Such provisions shall include but not be limited to temporary power, lighting, materials, equipment and/or installations (including removal and cleanup thereof) required to maintain such systems and as required to safely and properly complete the work.
- E. Contractor shall be liable for any and all damages resulting from unscheduled outages/interruptions or for those not confined to the pre-approved timeframes to complete the work.

3.3 DEMOLITION

- A. Comply with individual Division 23 sections and the following:
1. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas.

2. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
 3. Equipment: Unless otherwise directed, equipment, fixtures, or fittings being removed as part of demolition process are Owner's property. Remove other items not scheduled to be reused or relocated from job site as directed by Owner.
 4. Unless specifically indicated otherwise on Drawings, remove exposed, unused systems to behind finished surfaces (floor, walls, ceilings, etc.). Cap and patch surfaces to match surrounding finish.
 5. Unless specifically indicated otherwise on Drawings, remove unused equipment, fixtures, fittings, rough-ins, and connectors. Removal is to be to a point behind finished surfaces (floors, walls, and ceilings).
- B. If duct, pipe, insulation, conduits, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.
 - C. Reuse of Materials: Reuse of materials is prohibited unless specifically indicated or approved by Architect.
 - D. Notify Architect in discovery of any hazardous materials.
 - E. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.4 MECHANICAL SYSTEMS - COMMON REQUIREMENTS

- A. General: Install mechanical systems as described below, unless piping Sections specify otherwise. Individual Division 23 Sections specify unique installation requirements.
- B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of systems. Indicated locations and arrangements were used to size pipe and duct and calculate friction loss, expansion, pump sizing, fan sizing, and other design considerations. Install piping and ductwork as indicated, unless deviations to layout are approved on Coordination Drawings.
- C. Install piping at indicated slope.
- D. Install components with pressure rating equal to or greater than system operating pressure.
- E. Install piping and ductwork in concealed interior and exterior locations, except in equipment rooms and service areas.
- F. Install piping and ductwork free of sags and bends.
- G. Install exposed interior and exterior piping and ductwork at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.
- H. Install piping and ductwork tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
- I. Install piping and ductwork to allow application of insulation plus 1-inch clearance around insulation.
- J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- K. Install flexible connectors according to manufacturer's written instructions, and where indicated and specified in other Division 23 sections.
- L. Install flexible expansion loops according to manufacturer's written instructions, and where indicated and specified in other Division 23 sections.

- M. Install fittings for changes in direction and branch connections.
- N. Install couplings according to manufacturer's written instructions.
- O. Install Portable Instrument Connections in all piping systems where DDC temperature and/or pressure sensors and thermometers and/or pressure gauges are located.
- P. Do not route piping through elevator equipment rooms, unless specifically allowed by local authority.
- Q. Do not route piping over electrical panels, transformers, switchgear or other electrical equipment.
- R. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:
 - 1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish. Use split-casting escutcheons if required, for existing piping.
 - 2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
 - 3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
 - 4. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
 - 5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.
- S. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
- T. Exception: Extend sleeves installed in floors of equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 1. Build sleeves into new walls and slabs as work progresses.
 - 2. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS.
 - b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. If available, refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with non-shrink, nonmetallic grout.
 - d. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.
- U. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.

3. Assemble and install sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
- V. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using sleeve seals. Size sleeve for manufacturer's recommended clear space between pipe and sleeve.
1. Assemble and install sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.
 2. Caulk exterior side of annular space once the sleeve seal is in place using an elastomeric joint sealant.
- W. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe and duct penetrations. Seal pipe and duct penetrations with firestopping materials. If available, refer to Division 7 Section "Firestopping" for materials.
- X. Verify final equipment locations for roughing-in.
- Y. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- Z. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
 2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
 3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
 4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 5. 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:
 6. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 7. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
 8. Align threads at point of assembly.
 9. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
 10. 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.
 - a. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators.
 - b. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on

bolt threads. Tighten bolts gradually and uniformly using torque wrench to recommended torque values.

AA. Piping Connections: Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

BB. Identification

1. Valves:
 - a. Attach 1 1/2" square brass tags stamped with designating number 1/2" high, filled in with red enamel, to each valve.
 - b. Securely fasten valve tag to valve spindle or handle with a brass chain.
2. Schedules and Charts:
 - a. Furnish to Owner's representative three (3) complete framed plastic laminated valve tag schedules. Schedule shall indicate tag number, valve location by floor and nearest column number, valve size and fire area controlled.
 - b. Furnish three (3) framed plastic laminated diagrammatic charts showing schematically the complete sprinkler system, with major control valves and valve numbers.
 - c. Furnish one (1) framed plastic laminated placard at each sprinkler riser, indicating the basic hydraulic data as required by NFPA 13 or local Fire Marshal.
3. Piping Identification:
 - a. Apply color coded polyvinyl chloride pipe bands identifying service and direction of flow.
 - b. On exposed piping, apply bands at 20'-0" on centers at straight runs, at valve locations, and at points where piping enters and leaves a partition, wall, floor, or ceiling.
 - c. On concealed piping installed above removable ceiling construction, apply bands in manner described for exposed piping.
 - d. On concealed piping installed above non-removable ceiling construction, or in pipe shafts, apply bands at valves or other devices that are made accessible by means of access doors or panels.
 - e. Apply bands at exit and entrance points at each piece of equipment.
 - f. Band widths shall be 8" for pipes up to 10" diameter, and 16" for larger diameter piping. Letter heights stating service shall be pre-printed on band, 3/4" high for 8" bands and 1 1/4" high for 16" bands.
 - g. Colors shall conform to ASA Standard A13.1.
 - h. Tags and bands shall be approved for this service.

4. Sprinkler Drains and Test Connection

- a. Provide all necessary drain valves, drain risers, capped nipples, auxiliary piping, etc. as required to drain the system risers and mains, and all trapped portions of the system. Drain valves which are not connected to drain pipes leading to floor drains shall be hose end type.
- b. Main drains and test connections shall be piped to spill on/in floor drain or grade on concrete splash block.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.
- B. Install equipment according to approved submittal data.
- C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- D. Install 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.
- E. Install equipment giving right of way to piping installed at required slope.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor materials and equipment.
- B. Field Welding: Comply with AWS D1.1, "Structural Welding Code--Steel."

3.7 DRAWINGS

- A. The Drawings show the general arrangement and location of the ductwork, piping and equipment. Work shall be installed in accordance with the Drawings, except for changes required by conflicts with the work of other trades. The Contractor shall provide for the support, expansion, and pitch of any rearranged piping in conformance with the intent of the Drawings, Specifications, and codes.
- B. Note that certain mechanical work is shown, wholly or in part, on Architectural Drawings.
- C. Mechanical Drawings are diagrammatic and are intended to show the approximate location of equipment and piping. Dimensions shown on Drawings shall take precedence over scaled dimensions on Drawings. All dimensions shall be verified in the field by the Contractor.
- D. The exact location of apparatus, equipment, and piping shall be ascertained from the Owner or the representative in the field, and work shall be laid out accordingly. Should the Contractor fail to ascertain such locations the work shall be changed at Contractor's own expense when so ordered by the Owner. The Engineer and owner reserve the right to make minor changes in the location of ductwork, piping and equipment up to the time of installation without additional cost.
- E. It is the intention of the Drawings and Specifications that, where certain mechanical items such as unions, expansion joints, and other mechanical components are not shown, but where such items are required by the nature of the work, shall be furnished and installed.
- F. The Mechanical Drawings and Specifications are intended to supplement each other. Any material or labor called for in one shall be furnished even though not specifically mentioned in the other.

- G. Pipe and duct sizes shown are the minimum allowable and shall be increased in size if required by code or wherever necessary to meet unusual conditions.

3.8 DAMAGE

- A. Repair any damage to the building, premises, and equipment occasioned by the work under this Section.
- B. Repair all damage to any part of the building or premises caused by leaks or breaks in pipe, or malfunctions of equipment furnished or installed under this Section until the warranty period expiration date.

3.9 EARTHWORK

- A. General: Perform earthwork required for installation of new work below grade in accordance with referenced specifications.
- B. Excavate trenches to uniform widths to provide a working clearance on each side of the pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated. Grade trench bottoms to provide uniform bearing and support for each section of pipe. Form holes and depressions for joints after trench bottom has been graded. Provide temporary pumping equipment to keep excavation free from water. Install pipe bedding in rock excavation consisting of not less than 6 inch of sand or equivalent material.
- C. Provide bracing and shoring as necessary.
- D. Backfill trenches only after completion of pressure tests and inspection. Carefully compact material under pipe and bring backfill evenly up on both sides and along the full length of piping or conduit. Cover to 12-inch thickness over top of pipe. Fill and tamp remainder of backfill material in 6-inch layers. Provide backfill materials generally consisting of clean earth or sand relatively free of clods or stones. For sewer and water piping, use pea gravel. For gas piping, use sand. Backfill under, around, and to 6 inches above top of piping.
- E. Compact soil to 6-inch layer (maximum) loose thickness of backfill. Where roadway or parking area surfaces will be placed over backfill, provide moisture conditions, which will produce compacted density of 95 percent of maximum density. Elsewhere, 90 percent. Test in accordance with Divisions 1 and 2 (if applicable) and local code requirements (most stringent to prevail).
- F. Take special care in compacting under services where they enter building to prevent settling. Contractor fully responsible for damage to piping and property as a result of settling around service piping.
- G. Dispose surplus materials off-site in a suitable location.
- H. Place and maintain barricades, construction signs, torches, lanterns, and guards as required during periods of open excavation to protect persons from injury and to avoid property damage.
- I. Leave premises thoroughly clean at completion of earthwork.
- J. Wherever piping is to be installed in areas, which have been excavated below pipe inverts, for any purpose, install piping to prevent subsequent settlement. Do not install piping until backfill is to full compaction, completed to minimum 18 inch above installed pipe. Install piping in re-excavated trenches and backfill as previously specified.

3.10 CONCRETE WALLS AND CONCRETE FOOTINGS

- A. Where pipes must pass through concrete walls and footings, they shall pass through SDR 35 PVC pipe sleeves with 1/2" annular space set in place at time of construction.

- B. Ducts shall pass through 10 gauge galvanized sheetmetal sleeves. Provide sheetmetal closure collars at duct penetration.
- C. Sheetmetal sleeves set into concrete walls: Provide steel frame around opening where required by Structural Engineer.
- D. Coordinate core drilled openings with and General Contractor. Coordination shall include location, size, and spacing of openings. No slot openings will be allowed. Coordinate openings to avoid critical structural items such as reinforcing bars, tensioning tendons, etc.

3.11 ELECTRICAL REQUIREMENTS - CONTROLS AND COORDINATION WITH ELECTRICAL CONTRACTOR

- A. Contractor shall coordinate with the Electrical Contractor on furnishing and installing of controls, motors, starters, etc. Coordinate means informing Electrical Contractor of items requiring electrical connection, providing copies of submittal data, installation data, scheduling work to ensure efficient progress, and promptly supplying those items to be installed by Electrical Contractor.
- B. The specific requirements for electrical power and/or devices for each and every piece of mechanical equipment requiring electrical service, supplied and/or installed under this Contract, shall be coordinated and verified with the Mechanical drawings and specifications, and with the manufacturers of the equipment supplied. This shall include the voltage, phase, and ampacity; conduit requirements; and exact location and type of disconnect, control, and/or connection required. Any changes from the Drawings and Specifications required as a result of this coordination shall be part of this Contract.
- C. Electrical Contractor shall furnish and install the following for all mechanical equipment:
 1. Conduit and wiring for line voltage power to the equipment.
 2. Disconnect switches.
 3. Manual motor starters.
 4. Magnetic motor starters when part of a motor control center. See Division 26 and Drawings for further information.
- D. The work under this Section shall include furnishing and installing all controls on low and manual line voltage, including thermostats, auxiliary switches, relay wiring, interlock wiring; equipment control panels and transformers; and controls conduit unless specifically indicated as part of other work. Materials and methods of the control installation shall be in accordance with the Electrical Specifications.
- E. The Mechanical Contractor shall review all wiring connections which have any influence on this equipment or work and verify that these connections are correct before permitting any equipment to be operated which is furnished, installed, or modified under this Contract.

3.12 ELECTRICAL EQUIPMENT ROOM PRECAUTIONS

- A. Ductwork or piping for mechanical systems shall not be installed in any switchgear room, transformer vault, telephone room or electric closet except as indicated. In any case, no ductwork or piping for mechanical systems shall be installed in the space equal to the width and depth of any electrical service equipment, switchboards, panel boards, or motor control centers and extending from the floor to a height of six feet above the equipment or to the structural ceiling, whichever is lower.

3.13 CUTTING AND REPAIRING

- A. No cutting shall be done except with approval. Cutting of structural members or footings is prohibited without the prior written consent of the structural engineer.

- B. Where cutting of paving, walls, ceilings, etc. is necessary for the installation of the mechanical work, it shall be done under the direction of this Section. Damage caused by this cutting shall be repaired to match original and adjacent surfaces without additional expense to the Owner. Cutting of new construction shall be by the installing Contractor of that construction as directed by this Contractor.

3.14 ACCESSIBILITY

- A. General: Valves, damper operators, filters, thermometers, pressure gauges, clean-out fittings, and indicating equipment or specialties requiring reading, adjusting, inspection, repairing, removal, or replacement shall be conveniently and accessibly located with reference to finished building. Thermometers and gauges installed to be easily read from floor.
- B. Panels: No unions, flanges, valves, dampers, controls, or equipment shall be placed in a location that will be inaccessible after the system is complete. Access panels or doors shall be provided where required whether or not shown on Drawings.
- C. Access Panels in Walls or Ceilings:
 - 1. Provide access panels in walls or ceilings. Milcor or approved equal, where indicated and where required to provide access to valves, dampers, and other appurtenances. Panels shall be style as selected by and as directed by wall or ceiling construction. Panel size shall be 24" x 24" unless indicated otherwise. Panels in acoustical barriers shall have same transmission loss as barrier. Panels in rated construction shall have same rating as construction in which installed.
 - 2. Door panels shall be no lighter than 14 gauge steel. Doors shall be equipped with concealed spring hinges and flush, screwdriver operated locks, except that key operated locks shall be used for all access doors in walls where door is within 6'-0" of floor. Locks for all key operated doors shall be keyed alike.
 - 3. Doors in ceramic tile surfaces shall be stainless steel or chrome plated. Doors in other finished surfaces shall be prime coated.
 - 4. Doors in fire rated grease exhaust duct shafts shall be fire rated and openable without the use of tools.
- D. Equipment Spaces: Provide aisles between equipment and ducts, electrical gear, etc. for complete service and inspection of equipment. Maintain minimum 6'-6" headroom in all access aisles. Maintain minimum 36" clearance at all service panels. Provide minimum clearances at electrical equipment per NEC. Provide 36" wide, 3/4" thick plywood covered catwalks in attics from access door to equipment.

3.15 TESTING

- A. Test all piping, ductwork, equipment, and systems as called for in the Specifications. Notify and inspection authorities prior to testing so that they may be witnessed. Protect all personnel and equipment during testing. Where Specifications do not cover specific points or methods, conform to manufacturer's specifications.

3.16 OPENINGS

- A. Locating and sizing of all openings for pipe, conduit and ductwork through walls, roof, etc. shall be done under this Division. Framing of openings shall be done by the respective trades in whose work the opening is made.

3.17 EQUIPMENT

- A. All equipment shall be accurately set and leveled. Supports shall be neatly placed and properly fastened. All equipment shall be fastened in place with bolts.

- B. Keep all openings closed with plugs or caps to prevent entrance of foreign matter. Protect all piping, ductwork, fixtures, and equipment against dirt, water, chemical, or mechanical damage both before and after installation. Any equipment or apparatus damaged prior to final acceptance shall be restored to original condition or replaced at the discretion and at no additional cost to the Owner.
- C. Start-Up: Equipment shall be adjusted, lubricated, aligned, etc. prior to start-up. Inspect each piece of equipment prior to start-up. Start each piece of equipment in accordance with manufacturer's directions and warranty requirements.
- D. Finish: Protect all equipment and materials until in use. Any visible rust or corrosion shall be removed as directed prior to installation. All damaged factory painted finishes shall be cleaned and painted with manufacturer provided paint.

3.18 MANUFACTURER'S DIRECTIONS

- A. Materials and equipment shall be installed in accordance with manufacturer's application and recommendations, requirements, and instructions, and in accordance with Contract Documents. Where manufacturer's instructions differ from those indicated or specified, they shall be brought to attention for resolution prior to equipment ordering and installation.
- B. Where requirements indicated in Contract Documents exceed manufacturer's requirements, Contract Documents shall govern.

3.19 FURRING AND PIPE SPACES

- A. Spaces provided in the design of the building shall be utilized and the work shall be kept within the furring lines established on the Drawings.
- B. Layout: Maintain maximum head room under piping and equipment. Contractor to coordinate line locations with beams, windows, etc. to provide maximum clearance. From Drawings, ascertain heights of suspended ceilings and size of pipe shafts in which piping is concealed, and location and size of structural members in and adjacent to pipe shafts. Coordinate piping installation with ductwork, lighting, and other equipment. Ensure necessary clearances on trim plates at exposed penetrations of walls and floors. If sufficient room is not available above suspended ceiling or vertical shafts obtain clarification from before work is started.

3.20 CLEAN-UP

- A. During the course of work under this Section, all rubbish, debris, surplus materials, tools, etc. resulting from this work shall be removed from work area and shall be disposed of off-site at the end of each working day. The Owner's premises shall be left clean and in a condition acceptable to the owner.
- B. Clean all work installed under this Contract to satisfaction of Owner and submit documentation that each system has been cleaned and results witnessed by the representative.
- C. All water distribution and piping systems, including those for cold water and hot water systems, shall be flushed thoroughly until piping is cleaned to satisfaction of the owner. See other Specification Sections for additional requirements.

3.21 ENGRAVED NAMEPLATES

- A. Furnish and install plastic laminated engraved nameplates with 1/4" minimum lettering at panel mounted control devices, manual control stations, power disconnects, motor starters and pieces of equipment. Nameplates exposed to weather shall be engraved brass.

3.22 FINAL INSPECTION

- A. The Contractor shall furnish the certificates of final inspection and approval from the inspection authorities having jurisdiction.

3.23 SITE VISITS BY ENGINEER

- A. Engineer's responsibility is limited to normal construction support services only, consisting of office consultation, site visits, and reports at appropriate stages of construction such as rough-in, pre-final, and final.
- B. If the Engineer is requested for a site visit and the work performed to that point is not able to be reviewed, requiring an additional site visit, all costs incurred by the Engineer for additional site visits or office shall be paid for by that Contractor.

END OF SECTION

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes insulation for HVAC piping systems.
- B. Related Requirements:
 - 1. Section 230713 "Duct Insulation" for duct insulation.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 2. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 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.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.

1.04 INFORMATIONAL SUBMITTALS

- A. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- B. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.07 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.08 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
 - a. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Pittsburgh Corning Corporation.
 - ii. Owens Corning.

iii. Approved Equal

- b. Preformed Pipe Insulation without Jacket: Type II, Class 1, without jacket.
 - c. Preformed Pipe Insulation with Jacket: Type II, Class 2, with factory-applied ASJ ASJ-SSL jacket.
 - d. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
 - e. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials, Type II for sheet materials.
- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Aeroflex USA.
 - ii. Armacell LLC.
 - iii. K-Flex USA.
 - iv. Approved Equal
- H. Fiberglass (ASTM C547, Type 1 (Minus 20 Degrees F to 500 Degrees F):
- a. Fiberglass, UL-rated, preformed, sectional rigid, minimum 4 pounds per cubic foot (pcf) density, K factor 0.23 maximum at 75 degrees F mean, with factory-applied all-service jacket (ASJ) composed of reinforced kraft paper and aluminum foil laminate. Jacket shall have self-sealing lap to facilitate closing longitudinal and end joints.
 - b. Manufacturers and Products:
 - i. CertainTeed; Preformed Pipe Insulation.
 - ii. Johns Manville; Micro-Lok AP-T.
 - iii. Owens/Corning; Fiberglas Pipe Insulation.
 - iv. Knauf; Crown Pipe Insulation

2.02 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
- a. Manufacturers: available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Childers Brand; H. B. Fuller Construction Products.
 - ii. Foster Brand; H. B. Fuller Construction Products.
 - iii. Mon-Eco Industries, Inc.
 - iv. Vimasco Corporation.
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

- a. Manufacturers: available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Foster Brand; H. B. Fuller Construction Products.
 - ii. Approved Equal.
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Aeroflex USA.
 - ii. Armacell LLC.
 - iii. Foster Brand; H. B. Fuller Construction Products.
 - iv. K-Flex USA.
 - v. Approved Equal.
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - c. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
 - d. Wet Flash Point: Below 0 deg F.
 - e. Service Temperature Range: 40 to 200 deg F.
 - f. Color: Black Insert color.
- E. ASJ Adhesive and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
- a. Manufacturers: available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Childers Brand; H. B. Fuller Construction Products.
 - ii. Foster Brand; H. B. Fuller Construction Products.
 - iii. Mon-Eco Industries, Inc.
 - iv. Approved Equal.
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Johns Manville; a Berkshire Hathaway company.
 - ii. P.I.C. Plastics, Inc.
 - iii. Speedline Corporation.

- iv. The Dow Chemical Company.
- v. Approved Equal.
- b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.03 MASTICS AND COATINGS

- A. Materials shall be compatible with insulation materials, jackets, and substrates.
 - a. Mastics shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Childers Brand; H. B. Fuller Construction Products.
 - ii. Foster Brand; H. B. Fuller Construction Products.
 - iii. Knauf Insulation.
 - iv. Vimasco Corporation.
 - v. Approved Equal.
 - b. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 - c. Service Temperature Range: 0 to plus 180 deg F .
 - d. Comply with MIL-PRF-19565C, Type II, for permeance requirements
 - e. Color: White Insert color.

2.04 LAGGING ADHESIVES

- A. Adhesives shall comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
 - a. Manufacturers: available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Childers Brand; H. B. Fuller Construction Products.
 - ii. Foster Brand; H. B. Fuller Construction Products.
 - iii. Vimasco Corporation.
 - iv. Approved Equal.
 - b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - c. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 - d. Service Temperature Range: 0 to plus 180 deg F.
 - e. Color: White.

2.05 SEALANTS

- A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

- B. Joint Sealants:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Childers Brand; H. B. Fuller Construction Products.
 - ii. Foster Brand; H. B. Fuller Construction Products.
 - iii. Mon-Eco Industries, Inc.
 - iv. Pittsburgh Corning Corporation.
 - v. Approved Equal.

 - b. Permanently flexible, elastomeric sealant.
 - i. Service Temperature Range: Minus 150 to plus 250 deg F .
 - ii. Color: White.

 - c. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

- C. FSK and Metal Jacket Flashing Sealants:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Childers Brand; H. B. Fuller Construction Products.
 - ii. Foster Brand; H. B. Fuller Construction Products.
 - iii. Mon-Eco Industries, Inc.
 - iv. Approved Equal.

 - b. Fire- and water-resistant, flexible, elastomeric sealant.
 - c. Service Temperature Range: Minus 40 to plus 250 deg F.
 - d. Color: Aluminum.
 - e. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

- D. ASJ Flashing Sealants and PVDC and PVC Jacket Flashing Sealants:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Childers Brand; H. B. Fuller Construction Products.
 - ii. Insert manufacturer's name.

 - b. Fire- and water-resistant, flexible, elastomeric sealant.

- c. Service Temperature Range: Minus 40 to plus 250 deg F.
- d. Color: White.
- e. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.06 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - a. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
 - b. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
 - c. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.07 FIELD-APPLIED REINFORCING MESH

- A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
 - a. Manufacturers: available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Childers Brand; H. B. Fuller Construction Products.
 - ii. Approved Equal.
- B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Foster Brand; H. B. Fuller Construction Products.
 - ii. Vimasco Corporation.
 - iii. Approved Equal.
- C. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested in accordance with ASTM E96/E96M and with a flame-spread index of 10 and a smoke-developed index of 20 when tested in accordance with ASTM E84.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. ITW Insulation Systems; Illinois Tool Works, Inc.
 - ii. Approved Equal.

2.08 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. 3M Industrial Adhesives and Tapes Division.
 - ii. Avery Dennison Corporation, Specialty Tapes Division.
 - iii. Ideal Tape Co., Inc., an American Biltrite Company.
 - iv. Knauf Insulation.
 - v. Approved Equal.
 - b. Width: 3 inches Insert value.
 - c. Thickness: 11.5 mils Insert value.
 - d. Adhesion: 90 ounces force/inch Insert value in width.
 - e. Elongation: 2 Insert number percent.
 - f. Tensile Strength: 40 lbf/inch Insert value in width.
 - g. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. 3M Industrial Adhesives and Tapes Division.
 - ii. Ideal Tape Co., Inc., an American Biltrite Company.
 - iii. Approved Equal.
 - b. Width: 2 inches Insert value.
 - c. Thickness: 6 mils Insert value.
 - d. Adhesion: 64 ounces force/inch Insert value in width.
 - e. Elongation: 500 Insert number percent.
 - f. Tensile Strength: 18 lbf/inch in width.
- C. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. ITW Insulation Systems; Illinois Tool Works, Inc.
 - ii. Approved Equal.
 - b. Width: 3 inches Insert value.
 - c. Film Thickness: 2 mils Insert value.
 - d. Adhesive Thickness: 1.5 mils Insert value.
 - e. Elongation at Break: 120 Insert number percent.
 - f. Tensile Strength: 20 psi Insert value in width.

2.09 SECUREMENTS

- A. Bands:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. ITW Insulation Systems; Illinois Tool Works, Inc.
 - ii. RPR Products, Inc.
 - iii. Approved Equal.
 - b. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch 3/4 inch wide with wing seal or closed seal.
 - c. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch 3/4 inch wide with wing seal or closed seal.
- B. Staples: Outward-clinching insulation staples, nominal 3/4 inch wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy 0.062-inch soft-annealed, stainless steel 0.062-inch soft-annealed, galvanized steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - a. Verify that systems to be insulated have been tested and are free of defects.
 - b. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the tradesman 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.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. 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.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - a. Install insulation continuously through hangers and around anchor attachments.
 - b. 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 attached to structure with vapor-barrier mastic.
 - c. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - d. 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.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - a. Draw jacket tight and smooth.
 - b. 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 o.c.
 - c. 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 4 inches o.c.
 - i. For below-ambient services, apply vapor-barrier mastic over staples.
 - d. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 - e. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

- M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. 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 in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - a. Vibration-control devices.
 - b. Testing agency labels and stamps.
 - c. Nameplates and data plates.

3.04 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - a. Seal penetrations with flashing sealant.
 - b. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - c. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - d. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - a. Seal penetrations with flashing sealant.
 - b. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - c. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - d. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - a. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

- a. Pipe: Install insulation continuously through floor penetrations.
- b. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.05 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, Mechanical Couplings, and Unions:

- a. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
- b. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of 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.
- c. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that 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.
- d. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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.
- e. Insulate strainers using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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.
- f. Insulate flanges, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
- g. 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 reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
- h. 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.

- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. 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 as noted below. Installation shall conform to the following:
 - a. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
 - b. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 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.
 - c. 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.
 - d. 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.
 - e. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 INSTALLATION OF CELLULAR-GLASS INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - a. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
 - b. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - c. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
 - d. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, 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:
 - a. Install preformed pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - c. 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 that of pipe insulation.
 - d. 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:
 - a. Install preformed sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

- b. 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:

- a. Install preformed sections of cellular-glass insulation to valve body.
- b. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
- c. Install insulation to flanges as specified for flange insulation application.

3.07 INSTALLATION OF FIBERGLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

- a. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
- b. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
- c. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
- d. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, 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:

- a. Install preformed pipe insulation to outer diameter of pipe flange.
- b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
- c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
- d. 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:

- a. Install preformed sections of same material as that of straight segments of pipe insulation when available.
- b. 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:

- a. Install preformed sections of same material as that of straight segments of pipe insulation when available.
- b. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
- c. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
- d. Install insulation to flanges as specified for flange insulation application.

3.08 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- 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:

- a. Install pipe insulation to outer diameter of pipe flange.
- b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
- c. 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 that of pipe insulation.
- d. 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:

- a. Install mitered sections of pipe insulation.
- b. 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:

- a. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
- b. 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.
- c. Install insulation to flanges as specified for flange insulation application.
- d. 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.

3.09 INSTALLATION OF FIELD-APPLIED JACKETS

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

- a. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
- b. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
- c. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

- a. Draw jacket material smooth and tight.
- b. Install lap or joint strips with same material as jacket.
- c. Secure jacket to insulation with manufacturer's recommended adhesive.
- d. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
- e. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated and for horizontal applications, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

- a. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

- D. 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 o.c. and at end joints.
- E. Where PVDC jackets are indicated, install as follows:
 - a. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
 - b. Wrap factory-presizes 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.
 - c. 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.
 - d. 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.
 - e. 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.

3.10 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless steel jackets.

3.11 FIELD QUALITY CONTROL

- A. Tests and Inspections: 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 threaded valves, and two locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- B. All insulation applications will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.12 PIPING INSULATION SCHEDULE, GENERAL

- A. Insulation conductivity and thickness per pipe size shall comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.
- B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - a. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Low Pressure Steam 250 Deg F and Below:
 - a. NPS 3 and Smaller: Insulation shall be the following:
 - i. Fiberglass: 2 ½ inches thick.
 - b. PVC jacketing on exposed piping.
- B. Medium Pressure Steam Above 250 Deg F:
 - a. NPS 3 and Smaller: Insulation shall be the following:
 - i. Fiberglass: 4 inches thick.
 - b. PVC jacketing on exposed piping.
- C. Steam Condensate, Vents, Drains, and Safety Relief Vents 200 Deg F and Below:
 - a. NPS 2 and Larger: Insulation shall be the following:
 - i. Fiberglass: 2 inches thick.
 - b. NPS 1-1/2 and Smaller: Insulation shall be the following:
 - i. Fiberglass: 1 ½ inches thick.
 - c. PVC jacketing on exposed piping.

END OF SECTION

SECTION 23 22 13

STEAM AND CONDENSATE HEATING PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - a. Steel pipe and fittings.
 - b. Stainless steel pipe and fittings.
 - c. Joining materials.
- B. Related Requirements:
 - a. Section 232216 "Steam and Condensate Heating Piping Specialties" for strainers, flash tanks, special-duty valves, steam traps, thermostatic air vents and vacuum breakers, and steam and condensate meters.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - a. Steel pipe and fittings.
 - b. Stainless steel pipe and fittings.
 - c. Joining materials.
- B. Sustainable Design Submittals:
 - a. Product Data: For adhesives and sealants, indicating VOC content.
 - b. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.
 - c. Environmental Product Declaration: For each product.
- C. Submittal:
 - a. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
 - b. Locations of pipe anchors and alignment guides and expansion joints and loops.
 - c. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
 - d. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - a. Suspended ceiling components.
 - b. Other building services.
 - c. Structural members.
- B. Field quality-control reports.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications:
- B. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Pipe Welding: Qualify procedures and operators according to the following:
 - a. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
 - b. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures unless otherwise indicated:
 - a. MPS Steam Piping: 60 psig
 - b. LPS Steam Piping: 15 psig.
 - c. Condensate Piping: 15 psig at 250 deg F.
 - d. Blowdown-Drain Piping: Equal to pressure of the piping system to which it is attached.
 - e. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
 - f. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

2.02 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A53/A53M, black steel, plain ends, welded and seamless, Grade B, and Schedule as indicated in piping applications articles.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300 as indicated in piping applications articles.
- C. Malleable-Iron Threaded Fittings: ASME B16.3; Classes 150 and 300 as indicated in piping applications articles.

- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in piping applications articles.
- E. Cast-Iron Threaded Flanges and Flanged Fittings: ASME B16.1, Classes 125 and 250 as indicated in piping applications articles; raised ground face, and bolt holes spot faced.
- F. Wrought-Steel Fittings: ASTM A234/A234M, wall thickness to match adjoining pipe.
- G. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Butt welding.
 - c. Facings: Raised face.
- H. Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M, black steel of same Type, Grade, and Schedule as pipe in which installed.

2.03 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - a. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.
 - i. Full-Face Type: For flat-face flanges.
 - ii. Narrow-Face Type: For raised-face flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel or stainless steel of type to match pipe unless otherwise indicated.
- C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- D. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

PART 3 EXECUTION

3.01 LP AND MP STEAM PIPING APPLICATIONS

- A. LP Steam Piping, NPS 2 and Smaller: **Schedule 40**, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.
- B. LP Steam Piping, NPS 2-1/2 through NPS 12 : Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.
- C. Condensate piping above grade, NPS 2 and smaller, shall be:
 - a. Exposed: Schedule 80, Type S, Grade B, steel pipe; Class 125 cast-iron fittings; and threaded joints.

- b. Concealed: Schedule 80 Type E, Grade B steel pipe, Class 150 wrought steel fittings and welded joints.
- D. Condensate piping above grade, NPS 2-1/2 and larger, shall be :
- a. Schedule 80, Type E, Grade B, steel pipe; Class 150 wrought-steel fittings, flanges, and flange fittings; and welded and flanged joints.

3.02 ANCILLARY PIPING APPLICATIONS

- A. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- B. Vacuum-Breaker Piping: Outlet, same as service where installed.
- C. Safety-Valve-Inlet and -Outlet Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.03 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Slope steam piping minimum 1/2 inch per 10 feet in the direction of steam flow unless otherwise indicated on plans.
- C. Slope condensate piping 1/8 inch per foot in the direction of condensate flow unless otherwise indicated on plans.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. 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 otherwise indicated.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping to permit valve servicing.
- 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 groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

- M. Install drains, consisting of a tee fitting, NPS 3/4 full port-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.
- N. Install steam supply piping at a minimum uniform grade of 0.2 percent downward in direction of steam flow.
- O. Install condensate return piping at a minimum uniform grade of 0.4 percent downward in direction of condensate flow.
- P. Reduce pipe sizes using eccentric reducer fitting installed with level side down.
- Q. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to top of main pipe.
- R. Install valves according to valve specifications in Division 23
- S. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- T. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- U. Install shutoff valve immediately upstream of each dielectric fitting.
- V. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and full port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- W. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- X. Install drip legs at low points and natural drainage points such as ends of mains, bottoms of risers, and ahead of pressure regulators, and control valves.
 - a. On straight runs with no natural drainage points, install drip legs at intervals not exceeding 150 feet.
 - b. Size drip legs same size as main. In steam mains NPS 6 and larger, drip leg size can be reduced, but to no less than NPS 4.
- Y. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- Z. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- AA. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.04 INSTALLATION OF STEAM AND CONDENSATE PIPING SPECIALTIES

- A. Comply with requirements in Section 232216 "Steam and Condensate Heating Piping Specialties" for installation requirements for strainers, flash tanks, special-duty valves, steam traps, thermostatic air vents and vacuum breakers, and steam and condensate meters.

3.05 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic restraints in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for installation of hangers, supports, and anchor devices.
- C. Install the following pipe attachments:
 - a. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - b. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - c. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - d. Spring hangers to support vertical runs.
- D. Install hangers for steel steam supply piping and steel steam condensate piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Install hangers for fiberglass piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- F. Support horizontal piping within 12 inches of each fitting.
- G. Support vertical runs of steel steam supply piping and steel steam condensate piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.06 PIPE JOINT CONSTRUCTION

- A. Ream ends of pipes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. 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:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. 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.
- D. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.07 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install traps and 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 vacuum breakers downstream from control valve, close to coil inlet connection.
- E. Install a drip leg at coil outlet.

3.08 FIELD QUALITY CONTROL

- A. Prepare steam and condensate piping according to ASME B31.9, "Building Services Piping," and as follows:
 - a. Leave joints, including welds, uninsulated and exposed for examination during test.
 - b. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - c. Flush system with clean water. Clean strainers.
 - d. 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.
- B. Perform the following tests and inspections:
 - a. 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.
 - b. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the 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.
 - c. 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.
- C. Prepare test and inspection reports.

END OF SECTION

SECTION 23 22 16

STEAM AND CONDENSATE HEATING PIPING SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - a. Strainers.
 - b. Steam safety valves.
 - c. Steam traps.
 - d. Thermostatic air vents and vacuum breakers.
 - e. Flexible connectors.
- B. Related Requirements:
 - a. Section 230523.11 "Globe Valves for HVAC Piping" for specification and installation requirements for globe valves common to most piping systems.
 - b. Section 230523.12 "Ball Valves for HVAC Piping" for specification and installation requirements for ball valves common to most piping systems.
 - c. Section 230923.11 "Control Valves" for automatic control valve and sensor specifications, installation requirements, and locations.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - a. Strainers.
 - b. Steam safety valves.
 - c. Steam traps.
 - d. Thermostatic air vents and vacuum breakers.
 - e. Flexible connectors.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For valves, safety valves, pressure-reducing valves, steam traps, air vents, vacuum breakers, and meters to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to the following:
 - a. ASME Compliance: Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp flash tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressures and temperatures unless otherwise indicated:
 - a. HP Steam Piping: 60 psig.
 - b. LP Steam Piping: 15 psig.
 - c. Condensate Piping: 15 psig at 250 deg F.
 - d. Air-Vent and Vacuum-Breaker Piping: Equal to pressure of the piping system to which it is attached.
 - e. Safety-Valve-Inlet and -Outlet Piping: Equal to pressure of the piping system to which it is attached.

2.02 STRAINERS

- A. Y-Pattern Strainers, Cast Iron:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Keckley Company.
 - ii. Metraflex Company (The).
 - iii. Mueller Steam Specialty; A WATTS Brand.
 - iv. Titan Flow Control, Inc.
 - v. Insert manufacturer's name.
 - b. Body: ASTM A126, Class B cast iron, with bolted cover and bottom drain connection.
 - c. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
 - d. Strainer Screen: Stainless steel, 20 mesh strainer or perforated stainless-steel basket.
 - e. Tapped blowoff plug.
 - f. Rating: 250-psig working steam pressure.

2.03 STEAM SAFETY VALVES

- A. Bronze Brass Steam Safety Valves: ASME labeled.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Apollo Flow Controls; Conbraco Industries, Inc.
 - ii. Armstrong International, Inc.
 - iii. Kunkle Valve.
 - iv. Spirax Sarco Limited.
 - v. WATTS.
 - vi. Insert manufacturer's name.
 - b. Disc Material: Forged copper alloy.
 - c. End Connections: Threaded inlet and outlet.
 - d. Spring: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.

- e. Pressure Class: 250.
- f. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet, with threads complying with ASME B1.20.1.
- g. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

B. Cast-Iron Steam Safety Valves: ASME labeled.

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Apollo Flow Controls; Conbraco Industries, Inc.
 - ii. Armstrong International, Inc.
 - iii. Kunkle Valve.
 - iv. Spirax Sarco Limited.
 - v. WATTS.
 - vi. Insert manufacturer's name.
- b. Disc Material: Forged copper alloy with bronze nozzle.
- c. End Connections: Raised-face flanged inlet and threaded or flanged outlet connections.
- d. Spring: Fully enclosed cadmium-plated steel spring with adjustable pressure range and positive shutoff, factory set and sealed.
- e. Pressure Class: 250.
- f. Drip-Pan Elbow: Cast iron and having threaded inlet, outlet, and drain, with threads complying with ASME B1.20.1.
- g. Exhaust Head: Cast iron and having threaded inlet and drain, with threads complying with ASME B1.20.1.
- h. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.

2.04 STEAM TRAPS

A. Thermostatic Steam Traps, Bronze:

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Armstrong International, Inc.
 - ii. Barnes & Jones, Inc.
 - iii. Dunham-Bush, Inc.
 - iv. Hoffman Specialty.
 - v. Spirax Sarco Limited.
 - vi. Sterling.
 - vii. Tunstall Corporation.
 - viii. Insert manufacturer's name.
- b. Body: Bronze angle-pattern body with integral union tailpiece and screw-in cap.
- c. Trap Type: Balanced pressure.
- d. Bellows: Stainless steel or monel.
- e. Head and Seat: Replaceable, hardened stainless steel.
- f. Pressure Class: 125.

B. Float and Thermostatic Steam Traps, Cast Iron:

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Armstrong International, Inc.
 - ii. Barnes & Jones, Inc.
 - iii. Dunham-Bush, Inc.
 - iv. Hoffman Specialty.
 - v. Spirax Sarco Limited.
 - vi. Sterling.
 - vii. Tunstall Corporation.
 - viii. Insert manufacturer's name.
- b. Body and Bolted Cap: ASTM A126 cast iron.
- c. End Connections: Threaded.
- d. Float Mechanism: Replaceable, stainless steel.
- e. Seat: Hardened stainless steel.
- f. Trap Type: Balanced pressure.
- g. Thermostatic Bellows: Stainless steel or monel.
- h. Thermostatic air vent capable of withstanding 45 deg F of superheat and resisting water hammer without sustaining damage.
- i. Vacuum Breaker: Thermostatic with phosphor bronze bellows, and stainless steel cage, valve, and seat.
- j. Maximum Operating Pressure: 125 psig.

2.05 THERMOSTATIC AIR VENTS AND VACUUM BREAKERS

A. Thermostatic Air Vents:

- a. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Armstrong International, Inc.
 - ii. Barnes & Jones, Inc.
 - iii. Dunham-Bush, Inc.
 - iv. Hoffman Specialty.
 - v. Spirax Sarco Limited.
 - vi. Sterling.
 - vii. Tunstall Corporation.
 - viii. Insert manufacturer's name.
- b. Body: Cast iron, bronze, or stainless steel.
- c. End Connections: Threaded.
- d. Float, Valve, and Seat: Stainless steel.
- e. Thermostatic Element: Phosphor bronze bellows in a stainless steel cage.
- f. Pressure Rating: 125 psig 300 psig.
- g. Maximum Temperature Rating: 350 deg F.

B. Vacuum Breakers:

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Armstrong International, Inc.
 - ii. Dunham-Bush, Inc.
 - iii. Hoffman Specialty.
 - iv. Johnson Corporation (The).
 - v. Spirax Sarco Limited.
 - vi. Tunstall Corporation.
 - vii. Insert manufacturer's name.
- b. Body: Cast iron, bronze, or stainless steel.
- c. End Connections: Threaded.
- d. Sealing Ball, Retainer, Spring, and Screen: Stainless steel.
- e. O-Ring Seal: Ethylene propylene rubber.
- f. Pressure Rating: 125 psig 300 psig.
- g. Maximum Temperature Rating: 350 deg F.

2.06 FLEXIBLE CONNECTORS

A. Stainless Steel Bellows, Flexible Connectors:

- a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - i. Duraflex, Inc.
 - ii. Flexicraft Industries.
 - iii. Hyspan Precision Products, Inc.
 - iv. Mason Industries, Inc.
 - v. Metraflex Company (The).
 - vi. Twin City Hose, Inc.
 - vii. Insert manufacturer's name.
- b. Body: Stainless steel bellows with woven, flexible, bronze, wire-reinforced, protective jacket.
- c. End Connections: Threaded or flanged to match equipment connected.
- d. Performance: Capable of 3/4-inch misalignment.
- e. CWP Rating: 150 psig.
- f. Maximum Operating Temperature: 250 deg F.

PART 3 EXECUTION

3.01 VALVE APPLICATIONS

- A. Install shutoff duty valves at branch connections to steam supply mains, at steam supply connections to equipment, and at the outlet of steam traps.
- B. Install safety valves on pressure-reducing stations and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

3.02 INSTALLATION OF PIPING

- A. Install piping to permit valve servicing.
- B. Install drains, consisting of a tee fitting, NPS 3/4 full-port 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.
- C. Install valves according to Division 23 Specifications
- D. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment and elsewhere as indicated.
- E. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install strainers on supply side of control valves, pressure-reducing valves, traps, and elsewhere as indicated. Install NPS 3/4 nipple and full-port ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

3.03 INSTALLATION OF STEAM TRAPS

- A. Install steam traps in accessible locations as close as possible to connected equipment.
- B. Install full-port ball valve, strainer, and union upstream from trap; install union, check valve, and full-port ball valve downstream from trap unless otherwise indicated.

3.04 INSTALLATION OF SAFETY VALVES

- A. Install safety valves according to ASME B31.9, "Building Services Piping.
- B. Pipe safety-valve discharge without valves to atmosphere outside the building.
- C. Install drip-pan elbow fitting adjacent to safety valve and pipe drain connection to nearest floor drain.
- D. Install exhaust head with drain to waste, on vents equal to or larger than NPS 2-1/2.

END OF SECTION

SECTION 23 31 13

METAL DUCTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - a. Single-wall rectangular ducts and fittings.
 - b. Single-wall round ducts and fittings.
 - c. Sheet metal materials.
 - d. Sealants and gaskets.
 - e. Hangers and supports.
 - f. Seismic-restraint devices.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - a. Liners and adhesives.
 - b. Sealants and gaskets.

PART 2 PRODUCTS

2.01 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 with performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- C. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.02 SINGLE-WALL 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.
 - a. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse 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."
 - a. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
 - b. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," 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 in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "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."

2.03 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - a. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse 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 in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," 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. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "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."

2.04 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.
 - a. Galvanized Coating Designation: G60 G90.
 - b. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.
 - a. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - b. 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.

2.05 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 in accordance with UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - a. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - b. Tape Width: 3 inches 4 inches 6 inches.
 - c. Sealant: Modified styrene acrylic.
 - d. Water resistant.
 - e. Mold and mildew resistant.
 - f. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
 - g. Service: Indoor and outdoor.
 - h. Service Temperature: Minus 40 to plus 200 deg F.
 - i. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 - j. Sealant shall have a VOC content of 420 g/L or less.
- C. Water-Based Joint and Seam Sealant:
 - a. Application Method: Brush on.
 - b. Solids Content: Minimum 65 percent.
 - c. Shore A Hardness: Minimum 20.
 - d. Water resistant.
 - e. Mold and mildew resistant.
 - f. VOC: Maximum 75 g/L (less water).

- g. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
- h. Service: Indoor or outdoor.
- i. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

- a. Application Method: Brush on.
- b. Base: Synthetic rubber resin.
- c. Solvent: Toluene and heptane.
- d. Solids Content: Minimum 60 percent.
- e. Shore A Hardness: Minimum 60.
- f. Water resistant.
- g. Mold and mildew resistant.
- h. Sealant shall have a VOC content of 420 g/L or less.
- i. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
- j. Service: Indoor or outdoor.
- k. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

2.06 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- E. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
 - a. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - b. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - c. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 EXECUTION

3.01 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 in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. 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.
- J. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation.
- K. Elbows: Use long-radius elbows wherever they fit.
 - a. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
 - b. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.
- L. Branch Connections: Use lateral or conical branch connections.

3.02 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 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.

3.03 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - a. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.04 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "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.
 - a. Where practical, install concrete inserts before placing concrete.
 - b. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - c. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - d. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "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.

3.05 CONNECTIONS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.06 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Duct System Cleanliness Tests:
 - a. Visually inspect duct system to ensure that no visible contaminants are present.
- C. Duct system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.07 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.

3.08 INSTALLATION REQUIREMENTS FOR EXHAUST DUCTS SERVING COMMERCIAL DISHWASHERS

- A. Install dishwasher exhaust ducts without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to dishwasher or toward drain.
- B. Provide a drain pocket at each low point and at the base of each riser with a 1-inch trapped copper drain from each drain pocket to open site floor drain.
- C. Minimize number of transverse seams.
- D. Do not locate longitudinal seams on bottom of duct.

END OF SECTION

**SECTION 26 00 00
COMMON WORK RESULTS FOR ELECTRICAL**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Electrical materials and installation instruction common to most electrical systems and components including but not limited to equipment, raceways, fittings, sleeve/seals, sleeves, wires & connectors, conductors, demolition, equipment installation requirements common to equipment sections, painting and finishing, concrete bases, supports and anchorages, general coordination, electrical wiring, and device coordination.

1.02 DEFINITIONS

- A. Following is a list of abbreviations generally used in Division 26.
1. AHJ – Authority Having Jurisdiction.
 2. ETL – Electric Testing Laboratories.
 3. NEC – National Electric Code.
 4. NEMA – National Electrical Manufacturers Association.
 5. NFPA – National Fire Protection Association.
 6. OSHA – Occupational Safety and Health Administration.
 7. UL – Underwriters Laboratories Inc.
- B. Terms used on the drawings or in the specifications shall have the following meanings:
1. Approved Equal: An Item suggested by the Contractor that is allowed by the Engineer to replace an item listed in the Specifications or Drawings. The burden of proof of equality is the responsibility of the Contractor.
 2. Furnish: Supply and deliver, ready for installation, assembly or intended use, all materials, labor, equipment, testing apparatus, controls, tests, accessories, and all other items customarily required for the proper and complete application for the work referred to.
 3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at the project site as required to complete all items of work as required for the intended use/operation including all testing, certification, commissioning, and other requirements for final turnover to the Owner.
 4. Provide: "Furnish" and "Install".
 5. Owner Furnished, Contractor Installed: The Owner will furnish at his cost and the Contractor shall receive, protect, store, and install in the performance of the Work.
 6. Finished Spaces: Spaces other than electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
 7. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
 8. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include installations above ceilings, in shafts, trenches, partitions, or other enclosures.
 9. 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 embedded in or below masonry or concrete construction, earthwork/trenches, within unheated shelters, crawl spaces or enclosures.

10. Wiring: All wires, raceways, fittings, conductors, connectors, tape, junction and outlet boxes, connectors, splices, and all other items necessary and/or required in connection with such work.
11. Raceway: All raceways, conduit, fittings, hangers, supports, sleeves, etc.

1.03 GENERAL REQUIREMENTS

- A. Examine the Drawings, specifications and other Contract Documents relating to the Work and the work of all trades and become fully informed as to the extent and character of work required. Coordinate all work with that of others to ensure proper and complete installation of all materials, equipment and supports. It is the intent of the drawings, specifications, and related contract Documents to provide a complete working installation of all systems and equipment called for, in proper operating condition, finished, tested and ready for its intended use (hereinafter "Design Intent"). Provide all items not specifically shown on the drawings, called for in the specifications or related Contract Documents, but required to conform to the labor, material and equipment to achieve the Design Intent all and scaffolding, access provisions, tools, appliances, consumables, fees, permits and licenses, debris removal/disposal, supervision and labor, including required start-up, check-out and training to provide complete and fully operable systems in full compliance with the Contract Documents.
- B. Before submitting a bid and prior to the start of work, Contractor shall examine all conditions relating to the Work, including that associated with the work of other trades upon which Contractor's work may rely or otherwise depend, to achieve the Design Intent, in accordance with the best trade practices, workmanship and highest quality product installation, taking into account the sequence of the work, delivery, storage and hoisting requirements, requirements for access, testing and temporary services and all other site limitations and project complexities. Report to the Architect/Engineer any conditions which might prevent installation of materials and/or equipment in the manner intended by the Contract Documents or contrary to applicable codes, standards, or regulations.
- C. No consideration or allowance will be granted for any alleged misunderstanding of materials, equipment, or components to be furnished or work to be done; it being agreed that tender of proposal carries with it agreement to items, terms and conditions required by the Contract Documents.
- D. Site Visit – Visit the site and verify the exact conditions relating to the work and obtain such information as may be necessary to present a complete and comprehensive bid. No allowance will be made for any extra expense due to Contractor's failure to make such a visit and reasonably verify all actual/existing conditions. In the event of a conflict between existing conditions and the requirements of the Contract Documents, perform the necessary work to conform to Design Intent. The Owner or his representative will be the sole individual to interpret the intent of the Drawings in the event of a conflict between (1) existing conditions and those shown on the drawings, or (2) quality of existing material and quality of material indicated on the drawings or in the specifications. Wherever a conflict such as this occurs, the higher standard shall prevail.

1.04 SPECIAL REQUIREMENTS

- A. All seismic construction, restraints, bracing, mounts and hanging systems shall be in full compliance with the requirements of all Authorities Having Jurisdiction (AHJ's), pre-approval, certification, and engineering (including certified engineering calculations and stamps). Contractor shall be solely responsible for obtaining and complying with all requirements of the AHJ.

1.05 SUBMITTALS

- A. Reference Division 1 for submittal requirements.
- B. Submittal Schedule – Provide a detailed submittal schedule including all requirements of this Division and its subdivisions to the Architect and Engineer within thirty (30) days of contract award.
 - 1. Contractor shall submit for the Engineer's approval a Submittal Schedule for the performance of the work that is consistent with the requirements of the project schedule. The Submittal Schedule shall allow reasonable time for the Architect and other consultants review as specified in Division 1 Submittal Procedures. If the time for Architects/Engineers review is not otherwise specified, the review period (from date of receipt) shall be fifteen (15) business days. Once approved by the Architect/Engineer, submittal dates and time limits established by the Submittal Schedule shall not, except for reasonable cause, be changed or exceeded by the Contractor.
 - 2. For each submittal required by the Contract Documents the schedule shall include specification section number, subsection/paragraph identification number, item description (as stated in the applicable specification section, subsection, or other Contract Document) and the scheduled delivery date to the Architect/Engineer.
 - 3. Contractor shall be responsible to the Architect/Engineer and/or Owner for all costs, expenses and impact to the project schedule resulting from any deviation to the approved Submittal Schedule, including but not limited to; payment for required overtime, out-of-house resources/consultants or other higher cost resources of the Architect/Engineer as may be required to perform out of sequence, stacked, critical, delayed, unscheduled or multiple reviews of required submittals necessitated by rejection of a prior submittal, (cumulatively and hereinafter, "Additional Review Costs")
- C. General
 - 1. Review is for general conformance with the Contract Documents and is not intended to otherwise approve or verify dimensions, quantities, or to coordinate the Work shown on shop drawings on or between Contractor and the work of other trades or Sections. Contractor is solely responsible for quantities, dimensions, means and methods. Dimensions shall be confirmed and correlated by Contractor at the jobsite prior to the start of the Work (procurement, fabrication, construction, or other commencement activities). Contractor's failure to fully verify conditions at the jobsite prior to commencement of the work shall not relieve Contractor of its obligations under the Contract Documents and Contractor shall be responsible for all damages caused by or related to its failure to comply with the requirements of this provision.
 - 2. Submittal review shall be performed to show compliance with the design intent. Contractor shall specifically note any deviations from the Contract Documents and explain the reason and nature of the deviation. Such deviations will be reviewed or rejected on the submittal. Deviations not so identified shall not relieve the Contractor from the requirements of the Contract Documents.
 - 3. Resubmittals will be reviewed for compliance with comment(s) made on the original submittal only. Architect/Engineer shall not be responsible for changes made upon resubmittal that are not clearly identified (highlighted) and respond directly to the initial rejection. Resubmittals should not be packaged with non-related first-time submittals; all resubmittals must be marked with the resubmittal number and date and must otherwise comply with all submittal requirements.
 - 4. Submit shop drawings, commissioning plan(s) and checklists, penetration locations, supplemental data, etc. as may be requires by the Contract Documents for all materials, equipment and other components of the work included is all Sections of the Division and other provisions of the Contract Documents in accordance with the requirements of this Division and Division 1.
 - 5. All submittals must be reviewed by Contractor, and bear Contractor's review stamp and signoff for Conformity to the Contract Documents, prior to the submission of any required

submittal to Architect/Engineer. Submittals that fail to meet this requirement will be considered incomplete, will not be reviewed by Architect/Engineer, and will be returned to Contractor, without review and/or rejected and resubmittal will be required. Contractor shall be solely responsible for any and all Additional Review Costs and/or other project costs or schedule impact.

6. Forward all submittals to Architect/Engineer in a coherent, organized fashion, complete and packaged as required herein, Architect/Engineer may reject submittals that fail to comply with this, or any other provision of the Contract Documents and Contractor shall be solely responsible for any and all Additional Review Costs and/or other project costs or schedule impact.
7. Subject to other provisions of the Contract Documents and in the absence of a more stringent requirement, Architect/Engineer will review a submittal not more than two (2) times. Contractor shall be solely responsible for any and all Additional Review Costs and/or other project costs or schedule impact.
8. Identify each submittal item by reference to Specification Section paragraph in which item is specified, or drawing/detail number, as applicable. In addition, for equipment submittals, include identification numbers appearing on the equipment schedule.
9. Identify each item by manufacturer, brand, trade name, number, size, rating, or whatever other data is necessary to properly identify and check materials and equipment. Words "as specified" are not sufficient identification.
10. Organize submittals in same sequence as they appear in specification sections, articles, or paragraphs.
11. All materials and equipment submittals shall have a summary sheet at the front complete with catalog numbers. Where materials or equipment pertain to more than one building, submittals shall clearly indicate at which locations the materials or equipment is to be installed.
12. Submittals shall show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping and/or conduit entrance, access requirements for installation and maintenance, physical size and dimension, electrical characteristics and requirements, foundation/curbs, and all permanent and temporary support details as well as all information relating to weight, including but not limited to live and dead weights.

D. Catalog Cuts & Submittal Literature

Catalog cuts, submittal literature and published material may be included to supplement scale drawings.

1. Prepare submittals electronically in accordance with the following and Division 1
2. Submittal literature, drawings and diagrams shall be specifically applicable to this project and shall not contain extraneous material or optional choices. Clearly mark literature to indicate the proposed item. Substitutions: Comply with Division 1 Product Substitution Procedures.

E. Shop Drawings:

1. Shop drawings shall include all significant Division systems, equipment, and components, including but not limited to all terminal devices, connections, and elevations. Include all related specialty rooms (i.e., electrical, data/technology). Drawings shall be at a minimum scale of 1/4" per 1'-0" and shall be fully coordinated with the work of other trades and/or Sections.
2. Identify congested areas and clearly indicate solutions to space problems, developed in conjunction with the work of other trades and/or Sections. Identification of space problems without proposed solutions is not acceptable and is grounds for rejection. For such areas indicate, superimposed, the work of all trades and/or Sections involved and:
 - a. Clearly identify each area of congestion and deviations from the Contract Documents, and:
 - b. Proposed solution(s) clearly documented and signed-off by all other trades and/or Sections involved.

- F. Anchorage and Supports: Submit details and calculations for support and anchors that are not specifically detailed on the drawings. All calculations must meet 2018 IBC.
1. Provide details and calculations for electrical equipment per IBC 2018:
 - a. Having an operating weight over 400 pounds or more and mounted directly to the floor.
 - b. Having an operating weight over 20 pounds and suspended from the roof, floor, or wall or supported by vibration isolation devices.
 2. Where pre-approved bracing systems will be employed, submit:
 - a. System component brochure describing components used and detailed installation instructions.
 - b. Loads to be transmitted to the structure at anchor points.
 3. Where anchorage, support, and bracing are not detailed on the drawings, and pre-approved systems are not used, submit details and calculations of proposed systems.
 - a. Anchorage and Supports
 - 1) Where equipment substitutions change the weight, size, configuration, or other aspects of systems and equipment that will affect the performance of anchorages and/or supports, submit calculations for proposed anchors and supports, and install them as shown in these calculations.
 - 2) Where substitutions will have no effect on anchors and supports detailed on Contract Documents, submit information on sizes, weights, center of gravity and other relevant information to demonstrate this fact.
- G. Shop Fabrication Drawings: Drawings are for the Contractor's use and shall be its responsibility. Do not submit shop fabrication documents unless specifically requested.
- H. Testing and Balancing: Coordinate Shop Drawings to include any additional components for proper system testing and balancing.
- I. Certificates: Submit final inspection certificates signed by governing authorities.
- J. Operating and Maintenance Instructions and Manuals.
1. Instructions on major items, including but not limited to switchgear, generators, pumps, air compressors, water heaters, water softeners, specialty units, fans, air handlers, AC units and temperature controls, shall be by representative of manufacturer of respective equipment.
 2. Submit as identified below and as directed in Division 1.
 - a. Names, addresses and phone numbers of contractors and subcontractors. Alphabetical list of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.
 - b. Complete operating and maintenance instructions and parts lists of all equipment and component parts. Data sheets to show complete internal wiring, and electrical ratings and characteristics, catalog data on component parts whether furnished by equipment manufacturer or others, names, addresses and telephone numbers of source of supply for parts subject to wear or failure, and description of operating, test, adjustment, and maintenance procedures.
 - 1) Where data sheets included in manual cover equipment, options, or other features not part of equipment furnished, line out these references or otherwise clearly mark so remaining text, diagrams, drawings, schedules, and similar information shall apply specifically to equipment furnished.
 - c. Operating Instructions should include, but not be limited to:
 - 1) Normal starting, operational and shutdown procedures, including emergency procedures for each type of equipment/system.
 - 2) Equipment wiring diagrams.
 - 3) All other items as may be specified/required by this Section and the Contract Documents.

- d. Maintenance Instructions
 - 1) All items as may be specified/required by this Section and the Contract Documents.
- e. Manufacturers Data (each piece of equipment)
 - 1) Installation instructions
 - 2) Drawings & specifications
 - 3) Parts List, including recommended stock and long lead parts/components.
 - 4) Wiring and riser diagrams.
 - 5) Warranties and guarantees for all equipment, materials, and components, including repair, replacement and labor from both Contractor and manufacturer as required by the Contract Documents.
 - 6) Certificates of Installation – manufacturer’s certification of supervision during equipment installation and start-up procedures.
 - 7) Instruction certificates – certificates of compliance with Sections specific training and instruction programs.
 - 8) All other items as may be specified/required by this Section and the Contract Documents.

K. Record Documents.

- 1. Maintain one (1) complete set of blueline prints and specifications at the job site exclusively for recording deviations from the drawings which are necessary because of job conditions, request for information and/or approved change orders. Record locations and depths of buried and concealed conduits or other systems components from fixed, easily identifiable objects, such as building walls or other fixed physical objects. Where conduits are concealed in walls or other fixed physical objects, indicate distances from building corners or other building features not likely to be disturbed by fixture alterations. Drawings, specifications (as-builts) and approved submittals.
- 2. Where the project uses a BIM model the contractor shall keep the model updated in a similar fashion, maintaining the current project record as described in (a), above and submit, in addition to all other requirements of this Section and other provisions of the Contract Documents a complete and accurate BIM model for the project.
- 3. Prior to Substantial Completion, obtain from the Architect a complete set of electronic CADD drawings. Record all revisions to these drawings to indicate as-built conditions. Indicate all changes, including RFI’s, on this set of documents. Submit one set of blueprints of these revised drawings for review. Make necessary changes and deliver to Architect one set of reproducible and one electronic copy, including and BIM model, upon Final Completion and Acceptance. Refer to Division 1 for additional requirements.
- 4. Provide full size copies of record one-line diagrams, in metal frames with glass front. Obtain Record prints from Owner’s Representative at Contractor’s cost and have prints framed by a firm normally engaged in this work. Locate diagrams as directed.
- 5. All test reports, certifications, and inspection reports.
- 6. AHJ/Specialty AHJ Approvals (i.e., Fire Marshal and/or Fire Department system approvals).
- 7. Substantial and Final inspection certificate signed by governing authorities.
- 8. All other items as may be specified/required by this Section and/or other provisions of the Contract Documents.

1.06 EQUIPMENT DEVIATIONS & SUBSTITUTIONS

- A. See Division 1 for requirements and procedures related to Deviations and Substitutions. Unless specified elsewhere in the Contract Documents, a minimum of two (2) weeks shall be allowed for evaluation. The burden of all systems re-engineering/design, testing, suitability, and constructability is solely placed upon the Contractor for all deviations from the basis of design as reflected in the Contract Documents.

- B. No substitutions will be allowed and/or considered unless the description of a product includes the phrase “approved equal” and then only upon a determination as to equivalency and impact upon the project budget, schedule, and the work of others, including any redesign of the project or its system components by the Architect, Engineer, or other trades. The final determination as to sufficiency or acceptance of any such substitution and/or deviation properly requested and submitted by Contractor will lie solely with the Architect/Engineer. Contractor may not implement substitutions that have not been approved by Architect/Engineer.
- C. Where the contractor proposes to use an item of equipment other than that specified or detailed on the drawings which requires any redesign of any portion of the project, including but not limited to the mechanical, electrical, plumbing, structure, or architectural design or any of their respective subcomponents. Contractor shall be responsible to the Architect/Engineer and/or Owner for all costs, expenses and impact to the project budget and/or schedule resulting from any required investigation, analysis or redesign, including but not limited to; payment for required overtime, out-of-house resources/consultants or other higher cost resources of the Architect/Engineer, Owner or AHJ as may be required to perform the investigation, analysis or redesign (cumulatively and hereinafter, “Deviation Review Costs”)
- D. If approved by Architect/Engineer, all such redesign, including all new drawings and detailing required, will be prepared by the Architect/Engineer and their sub-consultants for Change Order documentation for approval by Owner and the Authority Having Jurisdiction will be paid by the Contractor as part of the Deviation Review Costs.
- E. Were such approved deviation requires a different quantity and arrangement of equipment, wiring, conduit, supports, foundations, pads, curbs, or equipment from that specified or indicated on the drawings or other Contract Documents, Contractor shall be responsible for all such costs, including the work of other trades and shall be solely responsible to furnish and install any such ductwork, piping, structural supports, insulation, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system at no additional cost or schedule impact to the project (cumulatively and hereinafter “Deviation Construction Costs”.

1.07 COORDINATION

- A. Drawings and corresponding electronic media are diagrammatic and indicate the general arrangement of systems and work included in the Work. Consult the drawings, details, and other electronic media for locations of fixtures and equipment; where same are not definitely located, obtain this information from the Architect/Engineer.
- B. The drawings and related electronic media have been made to scale with the best knowledge of conditions, dimensions, and space requirements available at the time of design and shall be followed as closely as possible during performance of the Work and coordination with the work of others. The foregoing however shall not relieve Contractor from its responsibility to verify all conditions. Dimensions and space requirements prior to commencement of the Work and to immediately report any errors or discrepancies to the Architect/Engineer.
- C. Check drawings and related electronic media of other trades to verify spaces and conditions in which work will be performed prior to commencement of the work.
- D. If directed by the Architect/Engineer or required for proper installation, execution and coordination of the work, the Contractor shall, without extra charge, make reasonable modifications in the layout as needed.

- E. Take all dimensions from Architectural and Structural Drawings, certified equipment drawings and from the actual field measurements before fabricating work. All conflicts shall immediately be reported to the Architect/Engineer. Contractor is solely responsible for conflicts known or which reasonably should have been know but not reported or resolved before commencement of the work.
- F. Equipment furnished shall fit in allocated space with due provision for manufacturer's recommended access and proper maintenance requirements. Verify and coordinate space requirements with all trades and equipment which comprise the Work.
- G. Prior to construction, coordinate the Work with that of other trades and building components. Prepare coordination drawings (or other specified electronic media) for all major trades, utilities and other primary systems routing in conjunction with the contract documents to maximize the pre-installation planning and coordination of trades, utilities and systems and minimize the requirement to manage field coordination through the RFI's, ASI's or other similar processes.
- H. Coordinate connection of systems with interior/exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- I. Before starting work, carefully examine the site and all Contract Documents. Become thoroughly familiar with new and existing conditions governing work on this project. Verify indicated elevations, building measurements, rough-in dimensions, and equipment locations before proceeding with any of the work.
- J. Drawings shall be accurately scaled to 1/8 inch – 1 foot or larger using the same version of AutoCAD or other electronic media as used by Architect/Engineer. Drawings shall include all addenda and Change Order items.
- K. Contractor shall be solely responsible for coordination and shall bear the cost of its failure to coordinate installation or of failure to advise Architect/Engineer of installation conflicts.
- L. Sequence, coordinate, and integrate installations of systems materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to building enclosure.

1.08 ELECTRICAL WIRING AND COORDINATION

- A. In general, power wiring will be provided under DIVISION 26 – ELECTRICAL, and control wiring will be provided under DIVISION 23 – HVAC, unless otherwise specified.
- B. The following schedule summarizes the division or work and material responsibilities.

ITEM	FURNISHED UNDER	SET IN PLACE OR MOUNTED UNDER	WIRED AND CONNECTED UNDER
Equipment motors	MD 1	MD 1	ED 2
Resistance heaters	MD	MD	ED
Fire protection controls, including remote switches, flow switches	MD	MD	ED

Motor controls where specified as an integral package	MD	MD	ED
Motor controllers	ED 4	ED 4	ED
Resistance type heater controllers	MD	ED 4	ED
Magnetic contactors and magnetic starters with overload trip assembly	ED 4	ED 4	ED
Integral control transformers	MD	ED 4	ED
Cover-mounted control devices	MD	ED 4	ED
Disconnect switches fused and unfused	ED 4	ED 4	ED
Thermal or thermal-magnetic circuit breakers	ED 4	ED 4	ED
Fuses	ED 4	ED 4	ED
Duct smoke detectors	ED	MD	ED 3
Smoke and fire/smoke dampers (with and without end switches)	MD	MD	ED 3
Control power source for temperature and equipment control panels	ED	ED	ED
Electric temperature control relays and miscellaneous devices	MD	MD 5	MD 5
Level and float switches	MD	MD 5	MD 5
Pipe mounted control devices such as flow switches, flow sensors, valves, and wells.	MD	MD 5	MD 5
Thermostats and space sensors.	MD	MD 5	MD 5
Duct mounted control devices such as temperature, humidity, flow and pressure sensors.	MD	MD 5	MD 5
Damper actuators.	MD	MD 5	MD 5
Control dampers.	MD	MD	--
Variable frequency drives (vfd) specified to be mounted on or in the mechanical equipment.	MD	MD	ED
VFD specified to be mounted separately from the mechanical equipment	MD	ED	ED

- C. Notes: (1) MD: Mechanical Divisions 21, 22, 23. (2) ED: Electrical Division 26. (3) Fire Alarm related, and power wiring provided under Division 28; Control-related wiring and relays provided under Division 21, 22, 23. (4) If furnished as part of factory equipment under Division 21, 22, 23, wiring and connections only by Electrical Division 26. (5) If any control devices carry the Full Load Current to any motor, they shall be furnished under Division 21, 22, 23, but shall be set in place and connected under Division 26.

1.09 ACCESSIBILITY

- A. Contractor is responsible for verifying that equipment and devices will fit within the space shown on the drawings. Contractor shall locate all equipment which must be serviced, operated, or maintained, as per NEC110.34 (Work Space & Guarding) and as per Table 110.34(A).
- B. Minor deviations from the drawings may be made to allow for better accessibility, but changes of magnitude or which involve extra cost shall not be made without approval from the Architect/Engineer.

1.10 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with a minimum of 5 years documented experience. Company personnel shall be approved by manufacturer for all product installations and required training.
- C. Conform to all applicable standards, codes and regulation and industry best practice requirements.
- D. All materials and equipment shall be new, shall bear manufacturer's name, and shall conform to the grade, quality and standards specified herein. Type, capacity, and application shall be suitable and capable of satisfactory operation for the purpose intended. All equipment and components shall include UL label and/or marking on equipment body/device including manufacturer's name, pressure rating(s), electrical classification(s), limits, and ratings as applicable to individual components for the purpose specified and intended.
- E. Equipment Selection: All items of a given type shall be the product of the same manufacturer. Equipment of greater or larger power, dimensions, capacities, and ratings may be considered provided such proposed equipment is approved in writing by Architect/Engineer and connecting electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. See Deviations & Substitutions for requirements. No additional costs will be approved for these increases if larger equipment is approved. If minimum energy ratings of efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.
- F. Listing and labeling: Provide motors that are listed and labeled. Terms "listed and labeled": as defined by UL, NEC, Article 100, or other applicable recognized agency as specified in the Contract Documents.
- G. Cutting & Patching: Unless otherwise required by the Contract Documents, Contractor shall be responsible for all cutting, fitting, and patching required to complete the Work, or to make portions of the Work and existing conditions fit together properly, and all such areas shall be restored to the conditions existing prior to the cutting, fitting, and patching unless otherwise provided in the Contract Documents.
- H. Contractor shall promptly correct any portion of the Work that is defective or not in accordance with the Contract Documents or rejected by the Architect/Engineer or Owner. Contractor shall be responsible for, and pay for all costs arising out of, any additional testing and inspections, demolition, uncovering and replacement and additional design and consulting services required to properly correct any portion of the Work.

- I. Contractor shall comply will comply with the Contract Documents and all Laws, standards, and handling criteria regarding hazardous substances, wastes and materials, including asbestos-containing materials, lead-based paints, petroleum (or any constituent thereof), mold, radon, and polychlorinated biphenyl (PCB), (“Hazardous Materials”) in performing the Work. Unless required by the Contract Documents, no Hazardous Materials shall be brought onto the Project.
- J. Lead Free Requirements: Contractor shall endeavor to use lead free products and where required by law, ordinance, regulation or standard all materials products and practices shall comply with limitations and requirements as to the allowable limits and/or percentages of lead. Lead free products must be certified by and independent 3rd party.
 - 1. This provision shall apply to any and all similarly regulated materials, products and practices that may be considered hazardous or are otherwise regulated by applicable law, ordinance regulation or standard in the project local.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. All materials and equipment shall be adequately covered and protected against dirt, water, chemical or mechanical damage, and theft. At completion, all work, equipment, and materials shall be cleaned, and damage repaired by Contractor. Damaged equipment will be replaced by the contractor if Owner does not accept repairs done to the equipment. Such replacement shall be scheduled to minimize building system interruption of occupied or scheduled for occupancy.
- B. Material delivered at the site shall not be left exposed to the weather or left unattended. Deliver pipes, tubes, and conduit with factory-applied endcaps. Contractor shall be responsible to maintain endcaps or provide temporary end caps on all open-ended piping, tubes and conduit through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- C. Protect stored material from moisture and dirt. Protect plastic pipes and materials from sunlight and support to prevent sagging and bending.
- D. Elevate stored materials above grade. When stored inside, to not exceed structural capacity of the floor.
- E. Provide protective coatings to materials to prevent damage and/or infiltration of moisture and dirt on all materials and equipment including but not limited to cast iron and steel valves.
- F. Contractor shall check the openings in the building and the size of the doors, passages, and openings through which equipment is to be admitted. Wherever necessary, he shall provide the equipment in sections or knocked down to admit the equipment through these openings.
- G. Contractor shall provide all rigging, erection and hoisting equipment as required to handle or place equipment and piping in position. This rigging and hoisting equipment shall only be attached and placed on the structure in locations as approved by Architect/Engineer at the site.

1.12 PERMITS, FEES & UTILITIES

- A. Obtain and pay for all necessary permits, fees and utilities and inspections required to perform the Work.
- B. Coordinate work with local regulatory entities, utility companies and others as required to fully comply with the requirements of this section and the Contract Documents, including those for both temporary and permanent services.

- C. Permits, fees and utility expenses to be paid by Owner, if any, shall only where specifically required by the Contract Documents, and then only to the extent so specified.

1.13 DOCUMENT OWNERSHIP

- A. The Drawings and Specifications, combined with the calculations, field data, notes, and reports, are the intellectual and real property of the Architect and/or Engineer. This covers all forms of written and recorded or electronic media. The reuse of these documents without specific permission of the Engineer is prohibited. The Drawings may be employed by the Owner and Contractor for the express use of constructing, commissioning, and operating the facility only upon proper execution of the Agreement for Use of Electronic Files & Data.

1.14 GUARANTEE AND WARRANTY

- A. Contractor warrants to Owner that the materials and equipment provided under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects. Work, materials, and equipment not conforming to these requirements, including substitutions not properly approved by Change Order, shall be considered defective. This warranty excludes remedy for damage caused by improper or insufficient maintenance, improper operation or normal wear, tear, and usage. Contractor shall assign to Owner, or otherwise assure the Owner has the full benefit of, all warranties and guarantees of manufacturer, subcontractors, sub-subcontractors and suppliers, and Contractor shall perform the Work in a manner that does not adversely affect or invalidate any available warranties or guarantees.
- B. Contractor shall warrant and guarantee all work against faulty material or workmanship for a period of one (1) year from the date of substantial completion and written acceptance by the Owner, unless specified more stringently elsewhere in the Contract Documents.
- C. If the project is occupied or the systems placed in operation in several phases at the request of the Owner, the guarantee of each system or piece of equipment used shall begin on the date each system or piece of equipment was placed in satisfactory operation, tested, commissioned, and accepted, in writing, by the Owner. The use of building equipment for temporary service and testing or phases of work completed prior to the project's final completion and acceptance by the Owner does not constitute the commencement of the warranty period.
- D. If a defect or deficiency in the Work is discovered within the one (1) year Warranty & Guarantee period or within such longer period as may be prescribed by the Laws or by any specific guarantee, and Owner elects to have Contractor correct such defect or deficiency, Owner shall notify Contractor of such defect or deficiency in writing. This period of correction relates only to the specific obligation to correct defects and deficiencies and in no way otherwise limits the Contractor's responsibility for Work that is not in accordance with the Contract Documents, If Contractor fails to timely correct defects or deficiencies in the Work, Owner may, at its sole option, correct them and charge contractor for all cost, therefore.
- E. See Division 1 – Closeout Submittals for additional warranty requirements.
- F. Minimum warranty for all material and workmanship for a minimum of 1-year after date of substantial completion OR for the extended period determined by the manufacturer's guarantee.
- G. Extended warranties may be required for specific items as noted in the Construction Standard

- H. Correct immediately any failure caused by poor material or workmanship during warranty period; within 72 hours of notice.
- I. If the Project Manager or Facilities Services personnel are required to proceed with repairs, the responsible party of the warranty will be billed for costs and damages when failing to comply.
- J. Specific exclusions, if any, from this one (1) year warrantee and guarantee period are listed in the individual specification sections.

1.15 LIMITATIONS OF LIABILITY

To the extent any of the following provisions are not more stringently included in the Contract Document the following Limitations of Liability shall apply:

- A. Architect/Engineer is not responsible for Contractor's means, methods, techniques, sequences or procedures of construction, or the safety precautions and programs incident thereto, and is not responsible for Contractor's failure to perform or furnish the work in accordance with the Contract Documents.
- B. If Architect/Engineer's employees or sub-consultants make comments or issue warnings about safety issues, such comments and warnings shall be considered to have been offered by a Good Samaritan and shall not impose any obligation or responsibility.
- C. Engineer will not be responsible for the acts or omissions of Owner, Contractor, any subcontractor, any supplier, or of any other person or organization performing or furnishing any of the portions of the work
- D. Contractor understands and acknowledges that Engineer is not authorized to order extra work or issue Change Orders to the work, however in the event and to the degree that Engineer may offer advice, suggestions, and opinions Contractor shall not rely on such advice, suggestions, and opinions unless directed in writing by Owner or its designated representative, and shall, in no event, make any claim against the Engineer for any such advice, suggestions, and opinions.
- E. To the fullest extent permitted by law, Contractor shall indemnify and hold harmless Architect, Engineer, and their joint ventures, officers, directors, partners, employees and agents from and against any and all claims, costs, loses and damages (including but not limited to all fees and charge of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) caused in whole or in part by the negligent acts or omissions of Contractor, Contractor's officers, directors, partners, employees, agents; or contractor's subcontractors or material men in the performance of Work. Contractor shall direct its insurer to list Architect, Engineer, and their joint ventures, as Additional Insureds on general liability insurance policies covering this project. Prior to commencing work, Contractor shall submit copies of its certificate of insurance to both Architect and Engineer.

PRODUCTS

1.16 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2. Manufacturer: Unless otherwise specified, company specializing in manufacturing specified products for at least 3 years.

1.17 MATERIALS AND EQUIPMENT

- A. The device numbers noted in this specification are generally those of a specific manufacturer and represent the minimum quality required as the basis of design for this project. Subject to the Substitutions and other provisions of the Contract Documents, Contractor may submit equivalent devices from the other manufacturers listed in the section.
- B. Materials and equipment used in carrying out these specifications shall be new and have UL listing or listing by other recognized testing laboratory when such listings are available.
- C. All material shall bear manufacturer's name, model number, electrical characteristics and other identification and shall be the standard product of manufacturer regularly engaged in production of similar material.
- D. Construction of equipment shall be as follows:
 1. All prefabricated equipment shall be designed and constructed in such a manner that all parts of said equipment and the equipment as a whole, including attachments, will resist the forces (including seismic where applicable) to which they may be subjected.
 2. Unless otherwise specified or required, design criteria shall be no less than 1.5g for lateral forces and 0.6g for vertical forces.
 3. Provisions for support and anchorage of equipment shall be an integral part of each item and shall include the fastening means and all necessary internal and external bracing, brackets and connections.
- E. Specifications for many items are or may be described on the drawings, including but not limited to wiring devices, lighting fixtures, control devices, etc. are or may be described on the drawings. Contractor shall promptly advise Architect of any conflicts or discrepancies.
- F. Except for conduit, conduit fittings, outlet boxes, wire, and cable (600V and below only), all items of equipment or material shall be the product of one manufacturer throughout.
- G. The documents contain specifications regarding equipment design, including BIL levels, AIC ratings, and series ratings. In all cases provide equipment sufficient for the use intended. Do not provide materials whose ratings fall below those included in the Documents.

PART 2 - EXECUTION

2.01 UTILITY SERVICE(S)

- A. Contractor shall be responsible for verifying and coordinating the work with local utility companies providing service to the facility and/or site and coordination with the work of others. This shall include, but not be limited to:
 1. Confirmation of schedule and service routing and sequence of the work to be performed by each utility, contractor, subcontractor, or others to ensure that the work can be performed without impact to the project schedule and with minimum interruption to services.
 2. Verification of utility services point of entry to the facility, including applicable invert elevations, proper placement of sleeves and/or penetrations and sealant thereof.

3. Establishing utility point of contact, documenting the local utility company representatives:
 - a. Company:
 - b. Contact Person:
 - c. Contact Telephone Number:
 - d. Provide required connections for each incoming utility service.

2.02 ELECTRICAL SYSTEMS

- A. Visit site and observe conditions under which work must be performed.
- B. Before starting work, carefully examine Architectural, Civil, Landscape, Structural, Plumbing, Heating, Ventilating and Air Conditioning drawings to become thoroughly familiar with conditions governing work on this project. Verify elevations, measurements, rough-in requirements of equipment and its installation location before proceeding with the work. Install equipment with access as required by the NEC.
- C. Circuit "tags" on the Electrical Drawings in the form of arrows are used to indicate home runs of raceways to electrical distribution points. These tags show the circuits in each home run and the panel designation. Do not combine circuits other than those shown or allowed on the Drawings. Show the actual circuit numbers on the finished record drawing, and on the panel directory card. Provide an insulated grounding conductor sized in accordance with NEC in every power circuit.
- D. The general directions and location of homeruns are indicated on Drawings and are to be extended to panels as though routes were completely shown. Items which are installed other than as shown on Drawings and without receiving prior written approval will be ordered removed and installed as shown without additional cost to Owner.
- E. The Drawings do not indicate the exact number of wires in each conduit for the branch circuit wiring. Provide the correct quantity of wires as indicated by: the circuit numbers indicated, wiring diagrams, and by applicable requirements of the NEC.
- F. Electrical Drawings are diagrammatic and shall not be scaled for exact sizes. Adjust location of conduits, panels, equipment, pull boxes and fixtures to accommodate the work and to prevent interferences.
 1. Lines which pitch have right-of-way over those that do not. Lines whose elevation cannot be changed have right-of-way over lines whose elevations can.
 2. Make offsets, transitions, and changes in direction in raceways as required to maintain proper headroom pitch of sloping lines.
- G. Wire and cable routing shown on the Drawings is approximate. Route wire and cable as required to meet Project Conditions.
- H. When wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.
- I. The Drawings are diagrammatic. They do not show every offset, bend, conduit body, elbow or junction box that may be required to install work in the space provided and avoid conflicts. Follow the Drawings as closely as is practical and install additional bends, offsets and elbows where needed by local job site conditions. Provide necessary junction boxes to meet code regulations for the allowed number of conduit bends.
- J. Establish sizes and locations of the various concrete bases required. Coordinate and provide all necessary anchor bolts together with templates for holding these bolts in position.

- K. Provide supports, blocking, hangers, and auxiliary structural members required for support of work.
- L. Furnish and set all sleeves for passage of raceways through structural, masonry, and concrete walls, floors, and elsewhere for proper protection of the raceways.
- M. Establish size, location, and count of cast-in conduits or conduits to be concealed underneath the foundations. Coordinate with steel reinforcing.
- N. The architectural drawings govern the locations and elevations of all electrical equipment, devices and fixtures. Resolve conflicts with the Architect prior to rough-in.
- O. Verify that the physical dimension of each item of electrical equipment will fit the available space. Coordinate electrical equipment space requirements with the allotted space provisions, and access routes through the construction area.
- P. Coordinate rough-in and wiring requirements for all mechanical, kitchen and other equipment with equipment supplier and installer. Make installation in accordance with rough-in and wiring diagrams provided by equipment supplier and installer.
- Q. Coordinate all aspects of the electrical, telephone and other utility services with the appropriate serving utility company.
- R. Coordinate underground work with other contractors working on the site. Common trenches may be used with other trades. In such areas, maintain clearances as required by codes and ordinances.
- S. Coordinate underground work with foundation plans and work.
- T. The location of utilities indicated on the plans is taken from existing public records. The exact location and elevation of public utilities must be determined by the Contractor. The Contractor shall ascertain whether any additional facilities other than those shown on the Drawings may be present.
- U. Call to the attention of the Architect any error, conflict or discrepancy in Plans and/or Specifications. Do not proceed with any questionable items of work until clarification of same has been made. Supplementary Details and Plans may be supplied as required and they will become a part of the Contract Documents.

2.03 EQUIPMENT INSTALLATION

- A. Follow manufacturer's instructions.
- B. Where the product has no manufacturer's instructions, follow these specifications. Where neither the manufacturer nor these specifications contain such instructions, install in accordance with the standards listed above. No allowance of any kind will be made for negligence on part of Contractor to foresee means of bringing in or installing equipment into position.
 1. Verify all dimensions by field measurements.
 2. Install systems, materials, and equipment to provide the maximum headroom possible.
 3. Install systems, materials, and equipment to comply with approved submittal data, including coordination drawings
 4. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

5. Fit surface panels, devices and outlets with neat, appropriate trims, plates or covers, without over-hanging edges, protruding corners or raw edges, to leave a finished appearance.
6. Extend maintenance and access components (i.e., grease fittings, service panels, and similar items) to accessible locations.
7. Install equipment to allow right of way for piping installed at required slope.

C. Locations:

1. Verify all locations with actual field conditions, architectural, structural, electrical, plumbing, heating, and ventilating plans to avert possible installation conflicts.
2. Architect reserves the right to make minor changes prior to installation without cost to Owner.
3. Coordinate work with that of other trades to assure symmetrical placing of fixtures, sprinkler heads and other exposed components with respect to ceiling tile, grilles, etc. See Architectural reflected ceiling plan for exact location of light fixtures and other equipment.
4. Any work which is incorrectly installed without prior verification without required coordination will be ordered removed and relocated and any changes or damage resulting to other work shall be repaired and/or replaced at no cost to the Owner.
5. In general, locate all finished devices or other exposed finished devices as indicated on or by symbols on drawings. Where devices or other exposed finished components occur in face, decks or base millwork, walls, ceilings or other finished surfaces carefully coordinate with details and arrangements of same.
6. All mounting heights shown on drawings are from finish floor to centerline unless otherwise indicated or required by code. Mounting heights at non-typical locations shown with (+) sign and height required noted adjacent to such device. Devices located in concrete block, brick or tile walls are to be adjusted in height to coordinate with modular joints of the materials. Verify requirements with Architect prior to installation.
7. Wiring Requirements: Install wiring complete to every outlet with all devices shown and/or required. All wiring to be in raceways and concealed throughout finished areas, including voice, data, controls, etc., unless specifically noted otherwise. For electrical specifications, all areas, except for boiler rooms, mechanical rooms and mechanical spaces, are to be considered as finished areas.

D. Equipment Connections

1. Coordinate the work with that of other trades to ensure all required connections are provided to ensure proper installation and operation.
2. Provide complete electrical connections for all items of equipment requiring such connections, including incidental wiring, materials, devices, and labor necessary for a finished working installation.
3. Verify the location and method for connecting to each item of equipment prior to roughing-in. Check voltage and phase of each item of equipment before connection.
4. Make motor connections for the proper direction of rotation.

2.04 NOISE CONTROL

- A. Provide insulation, isolators and other sound attenuation requirements as specified by Contract Documents.
- B. Back-to-back or straight through boxes are not permitted unless specifically noted on the drawings.
- C. Contactors, transformers, starters, and similar noise producing devices shall not be placed on walls which are common to occupied spaces unless specifically called for on the drawings.

Where equipment is mounted on wall common to occupied spaces, provide shock mounting or noise isolators to effectively prevent transmission to occupied spaces.

- D. Contactors, starters, transformers and like equipment found noticeably noisier than similar equipment of same type are to be removed and replaced as directed by Architect at no cost to owner.
- E. Route raceways along corridors or other noncritical noise space to minimize penetrations through sound rated walls. Seal raceway penetrations through sound rated walls.

2.05 FIRE WALL PENETRATIONS

- A. Perform necessary fire rated wall sealing for the work in accordance with Division 7 - Fire and Smoke Protection.
- B. Provide necessary wall material to maintain fire wall rating where flush mounted equipment or components installed.
- C. Where systems or components penetrate floors, ceilings, ducts, chases, and fire walls, provide fire stopping to maintain integrity of the fire assembly. Fire stopping method shall be approved by the authority having jurisdiction.
- D. Where electrical boxes with total area exceeding 16 square inches are in fire resistive walls, fire stopping shall be provided to maintain integrity of the fire assembly.
- E. Where electrical boxes are installed on opposite sides of a rated wall, horizontal separation between the boxes shall be a minimum of 24-inches. Horizontal separation of these boxes may be less than 24-inches if a UL approved protective material is utilized.
 - 4. Electrical boxes shall not be installed back to back in rated walls.
 - a. The aggregate surface area of the boxes shall not exceed 100 sq in per 100 sq ft of wall surface.

2.06 EQUIPMENT SUPPORT

- A. General
 - 1. Provide a system of supporting devices and hangers for support and bracing of piping, conduit and equipment as required by code or as provided under this Division as indicated on plans and as described herein.
 - 2. Do not install supporting devices so as to obstruct access to equipment.
 - 3. Floor-mounted equipment shall not be held in place solely by its own dead weight. Include floor anchor fastening in all cases.
 - 4. Do not support ductwork, piping, conduits, conductors, or equipment from other piping, conduits, ceiling grids, equipment, ductwork, or ceiling supports. In all cases, provide independent supports for such components and equipment.
- B. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to code (including seismic codes where applicable).
 - 1. Construct concrete bases and form equipment anchorages as detailed in the structural drawings.
 - 2. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's 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.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 7. Use concrete and reinforcement as specified in Division 3 Sections and the Structural Drawings.
- C. Metal Supports & Anchorages
1. Refer to local codes, practices and standards for installation and material requirements and limitations relating to the use of metal supports and anchorages (including applicable seismic requirements).
 2. Refer to Division 5 Section "Metal Fabrications" for structural steel.
 3. Field Welding: Comply with AWS D1.1.
- D. Wood Supports & Anchorages
1. Refer to local codes, practices and standards for installation and material requirements and limitations relating to the use of wood supports and anchorages (i.e., fire retardant materials).
 2. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor materials and equipment.
 3. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
 4. Attach to substrates as required to support applied loads.
- E. Grouting
1. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.
 2. Clean surfaces that will come into contact with grout.
 3. Provide forms as required for placement of grout.
 4. Avoid air entrapment during placement of grout.
 5. Place grout, completely filling equipment bases.
 6. Place grout on concrete bases and provide smooth bearing surface for equipment.
 7. Place grout around anchors.
 8. Cure placed grout.

2.07 PAINTING

- A. Painting of systems, equipment, and components is specified in Division 9. Unless and to the extent that painting is not specified elsewhere in the Contract Documents, all exposed materials in finished areas and on exterior walls shall be painted to match surrounding surfaces.
- B. Contractor shall be responsible for and shall coordinate the timing of painting with the work of other trades and to minimize the requirements for damage and touchup to the work.
- C. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

2.08 CUTTING, PATCHING AND CORE DRILLING

A. General

1. Refer to Divisions 1, 3 and other related provision of the Contract Documents, including Structural Drawings and Specifications for requirements relating to cutting, patching and core drilling of walls, floors and other surfaces.
2. Do not cut or break any steel or wood framing, concrete, masonry, or partitions, etc., without permission from the Architect or as shown on the Drawings.
3. Subject to the provisions of this Section and other portions of the Contract Documents cut, channel, chase and drill floors, walls, partitions and ceilings as necessary for the proper installation, support and anchorage of piping, ductwork, raceway, boxes, and other equipment.
4. Repair any damage to the building, piping, equipment, or finish.
5. Perform repairs with materials matching the original and install in accordance with appropriate sections of the Contract Documents.
6. Where trenching is done through existing paving, walks, curbs, etc. Contractor is responsible for patching and repairs to original condition.
7. In new work, patch and refinish all finished surfaces damaged by this contractor to match adjacent surface.
8. Where new work is installed in the existing building, patch and refinish surfaces damaged to match existing. Refinishing to be as directed by the Architect.
9. All related refinishing to be as directed by the Architect.

B. All cutting, patching and/or core drilling of structural systems that are do not appear on or that deviate in any way from the Structural Drawings must be preapproved by the Structural Engineer and Contractor shall provide all data, calculations and/or other requirements as maybe required by the Structural Engineer, prior to commencement of the work, including but not limited to:

1. X-Ray of structural systems to show the actual location of reinforcement.
2. Size and dimensions of penetrating ductwork, piping or conduit including placement within desired opening and required clearances, means of fastening and/or support including all anchoring systems and fasteners.
3. As a rule, subject to adjustment by Structural Engineer, penetrating ductwork, piping or conduit shall pass through the center of all structural openings, avoiding structural members by minimums specified on the Structural Drawings.

C. Core Drilling Layouts

1. Unless otherwise specified in the Contract Documents Contractor shall provide to the Structural Engineer a complete floor by floor core drilling layout for all required floor core penetrations in advance of the work for Structural Engineer's review and approval. Core drilling layouts shall include size, dimension, and specific locations of core drilling for all trades. Contractor shall not be permitted to conduct independent coring without providing such layout to Structural Engineer.

2.09 EXCAVATION, BACKFILL & WATERPROOFING

- A. Refer to Divisions 1, 2, and other related provisions of the Contract Documents, including but not limited to Sitework and Structural Drawings and related specifications for requirements relating to excavation, backfill and waterproofing for each trade.
- B. Do necessary trenching and excavating for installation of underground piping, raceways, and equipment. Use necessary precautions not to affect the bearing value of soil under and near footings. Excavate trenches with proper pitch six inches deeper than required by line grade and prefill to line grade with pea gravel. Where trenching occurs through existing paving, walks, curbs, etc., patch and repair to original conditions. Compact backfill with vibratory or roller compaction equipment in nine-inch layers to 90 percent density. Dispose of excess excavated material as directed. Backfill under floor slabs and under hard surfaced yard areas (i.e., walks,

drives, parking areas) to be crushed rock unless otherwise indicated, compacted in nine-inch layers. Backfill material and compaction to comply with Site Work Section of these Specifications.

- C. Provide and maintain ample means and devices with which to promptly remove and dispose of water entering the excavation during the time it is being prepared for the piping, raceways or equipment laying, during the laying of materials or equipment and until the backfill has been completed.
- D. Avoid, if possible, penetrations of waterproof membranes. Where such penetration is required, perform it prior to waterproofing and in accordance with Architectural details. Where penetrations are not detailed or must be conducted through waterproof membranes, provide a detail of the penetrations for approval of the Architect.

2.10 SAFETY & PROTECTION

- A. The Contract Documents do not include or is Architect/Engineer responsible for the design of construction details or instructions relating to Contractor' safety or protective measures or precautions or as it pertains to its means, methods, techniques, sequences or procedures required for to perform the work.
- B. Provide necessary shoring, railing, barricades, protective devices, temporary systems/supports, safety instructions and procedures to perform the work safely and to comply with the Safety Requirements of the governing authorities.
- C. Unless otherwise specifically detailed and included, the Contract Documents represent the finished state of all systems and components related to the work and it is Contractor's sole responsibility to provide the necessary means, methods, equipment and protection of the work and those performing the work during construction. Neither Architect/Engineer nor any of their respective subconsultants shall be responsible or liable for Contractor's failure to adequately protect the work or those performing the work during construction.

2.11 FUTURE PROVISIONS TO BE INCLUDED IN THE WORK

- A. The following provisions shall be provided for and included in the work:
 - 1. Provide pull line in each empty conduit provided for future installation of wiring.
 - 2. At all systems such as fire alarm, where future stations are to be fed from adjacent outlets or terminal cabinets, all conductors required for complete installation of additional units are to be provided to nearest outlet or terminal cabinet as required. In general, all wiring installed so it will not be necessary to remove existing conductors and re-pull additional wiring to install additional units. All spare conductors properly labeled and terminated in outlet boxes or at terminals in terminal cabinets.

2.12 CLEANING

- A. General
 - 1. At all times keep the premises free from accumulation of waste materials or rubbish caused by the employees or the work. At the completion of the work, remove all superfluous materials, equipment and debris related to or resulting from the work.
 - 2. All systems, equipment and component including but not limited to all panels, compartments, points of access, surface areas, panels, whether concealed or not shall

be free from debris, filings, clippings, dirt, dust and debris and in a new condition. Touch up paint where necessary.

3. Where existing systems are expanded and/or remodeled, clean the new installation prior to making final connection to the existing systems.

2.13 COOPERATION WITH OTHER TRADES

- A. Contractor shall cooperate with and coordinate the work with that of all other trades in the performance of the work, including but not limited to; delivery of equipment and materials, furnishing material and location requirements of sleeves, bucks, chases, supports, mountings, backings, inserts, anchor bolts, cast-in-place box-out or steel embeds, routings, sequencing, locations, finished devices, etc., for proper installation of its work. Contractor shall be responsible for any and all removal, replacement or repairs to its work or the work of others for its failure to fully comply with this provision.

2.14 OPERATION AND INSTRUCTION

- A. Upon completion of the work and prior to final acceptance, Contractor shall operate the equipment for a period as required to fully instruct the Owner and its authorized representatives in all details of operation, adjustment, and maintenance. Absent more stringent requirements found elsewhere in the Contract Documents, Contractor shall, at a minimum:
 1. Schedule with Owner and its designated representatives a single time and location for a 1-day instruction class and submit 3 copies of certificate, signed by Owner's representatives, attesting to the Owner's authorized representatives having been so instructed. All arrangements shall be made through Architect and Owner's Representative.
 2. Thoroughly review and instruct Owner and its designated representatives on all aspects of systems and facilities operations and maintenance utilizing the Instructions and Manuals submitted under the provisions of this Section. Any required instructions from manufacturer's representatives shall be given during this period.
 3. This requirement is in addition to any "Operation Test" specified in the Contract Documents.

END OF SECTION 26 00 00

**SECTION 26 05 09
EQUIPMENT WIRING**

PART 1 – GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Equipment connections, whether furnished by Owner or other Divisions of the Contract.
 - 2. Equipment grounding.

1.02 RELATED SECTIONS

- A. Contents of Division 26, Electrical and Division 01, General Requirements (if available) apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements (if available).

1.04 SUBMITTALS

- A. Submittals as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements (if available).
- B. In addition:
 - 1. Verify mechanical and utilization equipment electrical characteristics with Drawings and equipment submittals prior to ordering equipment. Submit confirmation of this verification as a part of, or addendum to, the electrical product submittals.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 26 00 00, Electrical Basic Requirements and Division 01; General Requirements (if available) apply to this Section.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00, Electrical Basic Requirements and Division 01, General Requirements (if available).

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Materials and Equipment for Equipment Wiring: As specified in individual Sections.

2.2 GENERAL

- A. Unless otherwise noted, the following voltage and phase characteristics apply to motors:
 - 1. 3/4 HP and Under: 120 volt, 1 phase.
 - 2. 1 HP and Over: 208 volt, 3phase.
 - 3. 1 HP and Over: 480 volt, 3phase.

- B. Safety Switches: Provide as required by NEC and as specified in Section 26 28 16, Enclosed Switches and Circuit Breakers.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Prior to submittal of product data for electrical distribution equipment, obtain and examine product data and shop drawings for equipment furnished by the Owner and by other trades on the project. Update the schedule of equipment electrical connections, accordingly, noting proper ratings for overcurrent devices, fuses, safety disconnect switches, conduit and wiring, and the like. As a minimum, this requirement applies to equipment furnished by Owner and equipment furnished under the following divisions of work under this contract:
 - 1. Division 10, Specialties
 - 2. Division 11, Equipment
 - 3. Division 21, Fire Suppression
 - 4. Division 22, Plumbing
 - 5. Division 23, HVAC, Heating, Ventilating and Air Conditioning
 - 6. Division 27, Communications
 - 7. Division 28, Electronic Safety and Security

3.2 INSTALLATION

- A. Do not install unrelated electrical equipment or wiring on mechanical equipment without prior approval of Engineer.
- B. Provide moisture tight equipment wiring and switches in ducts or plenums used for environmental air.
- C. Connect motor and appliance/utilization equipment complete from panel to motor/equipment as required by code.
- D. Install motor starters and controllers for equipment furnished by others.
- E. Appliance/Utilization Equipment:
 - 1. Provide appropriate cable and cord cap for final connection unless equipment is provided with same. Provide receptacle configured to receive cord cap.
 - 2. Verify special purpose outlet NEMA configuration and ampere rating with equipment supplier prior to ordering wiring devices and cover plates.
- F. Door Hardware:
 - 1. Provide dedicated circuit from nearest 208/120V emergency panelboard for door hardware power supplies. Provide complete control connections for door hardware locking mechanisms to building security system.
 - 2. Coordinate with Division 08, Openings and Drawing requirements.

3.3 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Division 01, General Requirements.

3.4 SYSTEMS STARTUP

- A. Provide field representative to prepare and start equipment.
 - 1. Test and correct for proper rotation of polyphase motors.
- B. Adjust for proper operation within manufacturer's published tolerances.
- C. Demonstrate proper operation of equipment to Owner's designated representative.

END OF SECTION

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Copper building wire rated 600 V or less.
 - 2. Mineral-insulated cable, Type MI, rated 600 V or less.
 - 3. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
 - 1. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.
 - 2. Section 271323 "Communications Copper Backbone Cabling" for twisted pair cabling used for data circuits.
 - 3. Section 271000 "Structured Cabling System" for twisted pair cabling used for data circuits.

1.03 DEFINITIONS

- A. VFC: Variable-frequency controller.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.01 COPPER BUILDING WIRE

- A. Description: Flexible, insulated, and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers:
 - 1. Belden Inc
 - 2. General Cable Tech
 - 3. Southwire Company
 - 4. Or approved equal
- C. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- E. Conductor Insulation (copper only):
 - 1. Type THHN-2: Comply with UL 83.
 - 2. Type THWN-2: Comply with UL 83.
 - 3. Type XHHW-2: Comply with UL 44.
- F. Shield:
 - 1. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

2.02 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers:
 - 1. AFC Cable
 - 2. Hubbell Power Systems
 - 3. O-Z/Gedney
 - 4. Thomas & Betts Corp
 - 5. Or approved equal.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc diecast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Type: One hole with standard barrels.
3. Termination: Compression.

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Feeders: Copper for feeders smaller than No. 4 AWG; copper for feeders No. 4 AWG and larger. Conductors shall be stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Branch Circuits: Copper. Stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- D. Branch Circuits: Copper. Stranded for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- E. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.
- F. Power-Limited Fire Alarm and Control: Stranded for No. 12 AWG and smaller.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Not allowed.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- D. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- H. VFC Output Circuits: Type XHHW-2 in metal conduit.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in raceway only in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. 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.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.04 CONNECTIONS

- A. 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-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.05 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.07 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.08 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors.
 - 2. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
 - 3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION

**SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:

1. Steel slotted support systems.
2. Aluminum slotted support systems.
3. Nonmetallic slotted support systems.
4. Conduit and cable support devices.
5. Support for conductors in vertical conduit.
6. Structural steel for fabricated supports and restraints.
7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
8. Fabricated metal equipment support assemblies.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.
 - i. Brackets.
2. Include rated capacities and furnished specialties and accessories.

- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.

4. 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.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Suspended ceiling components.
 2. Ductwork, piping, fittings, and supports.
 3. Structural members to which hangers and supports will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Items penetrating finished ceiling, including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Projectors.
- B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, 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.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M.
 2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified.
 2. Component Importance Factor: 1.0.

2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
1. Manufacturers:
 - a. Allied Tube & Conduit
 - b. B-Line
 - c. Haydon Corp.
 - d. Thomas & Betts Corp.
 - e. Or approved Equal
 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 3. Material for Channel, Fittings, and Accessories: Galvanized steel.
 4. Channel Width: Selected for applicable load criteria.
 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.
1. Manufacturers:
 - a. Cooper Industries
 - b. Haydon Corp.
 - c. Thomas & Betts
 - d. Or approved equal
 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 3. Channel Material: 6063-T5 aluminum alloy.
 4. Fittings and Accessories Material: 5052-H32 aluminum alloy.
 5. Channel Width: Selected for applicable load criteria.
 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with minimum 13/32-inch- (10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least one surface.
1. Manufacturers:
 - a. Allied Tube & Conduit
 - b. B-Line
 - c. Haydon Corp.
 - d. Or approved equal
 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 3. Channel Width: Selected for applicable load criteria.

4. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
 5. Fitting and Accessory Materials: Same as those for channels and angles, except metal items may be stainless steel.
 6. Rated Strength: Selected to suit applicable load criteria.
 7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored 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 made of malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- G. 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. Manufacturers:
 - 1) Hilti, Inc.
 - 2) ITW Ramset
 - 3) MKT Fastening
 - 4) Or approved equal
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers:
 - 1) B-line
 - 2) Hilti, Inc.
 - 3) ITW Ramset
 - 4) Or approved equal
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are like MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: Stainless-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.03 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 Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1.
 - 2. NECA 101
 - 3. NECA 102.
 - 4. NECA 105.
 - 5. NECA 111.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.02 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 may be supported by openings through structure members, according to 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. (90 kg).

- 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 (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 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.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "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.

3.04 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 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 minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Touchup: Comply with requirements in Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

**SECTION 26 05 33
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections (if available), apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Nonmetal wireways and auxiliary gutters.
 - 5. Boxes, enclosures, and cabinets.
 - 6. Handholes and boxes for exterior underground cabling.

1.03 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.04 ACTION 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, and attachment details.

PART 2 - PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
 - 1. Manufacturers:
 - a. AFC Cable Systems
 - b. Allied Tube & Conduit
 - c. Western Tube and Conduit
 - d. Or Approved Equal

2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. ARC: Comply with ANSI C80.5 and UL 6A.
5. IMC: Comply with ANSI C80.6 and UL 1242.
6. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit, IMC.
 - a. Comply with NEMA RN 1.
 - b. Coating Thickness: 0.040 inch (1 mm), minimum.
7. EMT: Comply with ANSI C80.3 and UL 797.
8. FMC: Comply with UL 1; zinc-coated steel or aluminum.
9. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Manufacturers:
 - a. AFC Cable Systems
 - b. Allied Tube & Conduit
 - c. Western Tube and Conduit
 - d. Or Approved Equal
2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
6. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: clamp/bolt-on.
7. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

- C. 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.

2.02 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Manufacturers:
 - a. AFC Cable Systems
 - b. Allied Tube & Conduit
 - c. Western Tube and Conduit
 - d. Or Approved Equal
2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fiberglass:
 - a. Comply with NEMA TC 14.

- b. Comply with UL 2515 for aboveground raceways.
 - c. Comply with UL 2420 for belowground raceways.
 - 4. ENT: Comply with NEMA TC 13 and UL 1653.
 - 5. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
 - 6. LFNC: Comply with UL 1660.
 - 7. Rigid HDPE: Comply with UL 651A.
 - 8. Continuous HDPE: Comply with UL 651A.
 - 9. Coilable HDPE: Preassembled with conductors or cables and complying with ASTM D 3485.
 - 10. RTRC: Comply with UL 2515A and NEMA TC 14.
- B. Nonmetallic Fittings:
- 1. Manufacturers:
 - a. AFC Cable Systems
 - b. CANTEX INC
 - c. Thomas & Betts Corp.
 - d. Or Approved Equal
 - 2. Fittings, General: Listed and labeled for type of conduit, location, and use.
 - 3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
 - a. Fittings for LFNC: Comply with UL 514B.
 - 4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.03 METAL WIREWAYS AND AUXILIARY GUTTERS

- 1. Manufacturers:
 - a. B-Line
 - b. Hoffman
 - c. Square D
 - d. Or Approved Equal
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1, Type 3R, Type 4X, unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 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.

2.04 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- 1. Manufacturers:
 - a. Allied Moulded Products
 - b. Hoffman
 - c. Or Approved Equal

- B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

2.05 BOXES, ENCLOSURES, AND CABINETS

- 1. Manufacturers:
 - a. B-Line
 - b. Hoffman
 - c. Square D
 - d. Or Approved Equal
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb. (23 kg) shall be listed and marked for the maximum allowable weight.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- K. Gangable boxes are allowed.
- L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 & Type 3R, Type 4 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.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

M. Cabinets:

1. NEMA 250, Type & Type 3R 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.

2.06 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers:
 - a. Armorcast Products Comp.
 - b. Oldcastle Enclosure
 - c. Quarzite
 - d. Or Approved Equal
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC."
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC.

4. Retain first option in first subparagraph below if raceway may be exposed to physical damage.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway 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. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 1/2-inch trade size.

D. Raceway Fittings: Compatible with raceways 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 clamp/bolt-on, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.02 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits.

Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of four 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- L. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from ENT to GRC before rising above floor.
- M. Stub-Ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- S. 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.
- T. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. Install pull wires in empty raceways. 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. Cap underground raceways designated as spare above grade alongside raceways in use.
- V. Install raceway sealing fittings at accessible locations according to NFPA 70 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 like that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- W. Install devices to seal raceway 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 raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Conduit extending from interior to exterior of building.
 - 4. Conduit extending into pressurized duct and equipment.
 - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - 6. Where otherwise required by NFPA 70.
- X. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- Y. 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 conduit 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:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.

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.
- Z. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches (915 mm) of flexible conduit for recessed and semi recessed luminaires, 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.
- AA. 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.
- BB. 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 surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- CC. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
- DD. Locate boxes so that cover or plate will not span different building finishes.
- EE. 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.
- FF. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- GG. Set metal floor boxes level and flush with finished floor surface.
- HH. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit.
 2. Install backfill.
 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install handholes with bottom below frost line.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.06 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.07 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and 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 26 05 33

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Color and legend requirements for raceways, conductors, and warning labels and signs.
 - 2. Labels.
 - 3. Bands and tubes.
 - 4. Tapes and stencils.
 - 5. Tags.
 - 6. Signs.
 - 7. Cable ties.
 - 8. Paint for identification.
 - 9. Fasteners for labels and signs.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Comply with ASME 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. Comply with NFPA 70E requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient.

2.02 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder conductors.
 - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. Color for Neutral: White
 - 5. Color for Equipment Grounds: Green
 - 6. Colors for Isolated Grounds: Green with white stripe.
- C. Raceways and Cables Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
- D. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
- E. Warning labels and signs 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 (915 MM)."

F. Equipment Identification Labels:

1. Black letters on a white field.

2.03 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

1. Manufacturers:
 - a. Brady Corp.
 - b. Emedco
 - c. Panduit Corp.
 - d. Or Approved Equal

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers:
 - a. Brady Corp.
 - b. HellermannTyton
 - c. Panduit Corp
 - d. Or Approved Equal

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Manufacturers:
 - a. Brady Corp.
 - b. Brother International
 - c. Emedco
 - d. Ideal Industries
 - e. Or approved Equal

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.

3. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.

4. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil- (0.08-mm-) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers:
 - a. Brady Corp.
 - b. Brother International
 - c. Emedco

- d. Ideal Industries
 - e. Or approved Equal
2. Minimum Nominal Size:
- a. 1-1/2 by 6 inches (37 by 150 mm) for raceway and conductors.
 - b. 3-1/2 by 5 inches (76 by 127 mm) for equipment.
 - c. As required by authorities having jurisdiction.

2.04 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.
- 1. Manufacturers:
 - a. Brady Corp.
 - b. HellermannTyton
 - c. Panduit Corp
 - d. Or approved Equal
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.
- 1. Manufacturers:
 - a. Brandy Corp
 - b. Panduit Corp
 - c. Or approved Equal

2.05 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- 1. Manufacturers:
 - a. Carlton Industries
 - b. Champion America
 - c. HellmannTyton
 - d. Ideal Industries Inc
 - e. Or approved Equal
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.
- 1. Manufacturers:
 - a. Brady Corp
 - b. Carlton Industries
 - c. Marking Services
 - d. Or approved Equal
- C. Tape and Stencil: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers placed diagonally over orange background and are 12 inches (300 mm) wide. Stop stripes at legends.

1. Manufacturers:
 - a. Brimar Industries
 - b. HellermannTyton
 - c. Marking Services, Inc
 - d. Or approved equal

- D. Floor Marking Tape: 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.
 1. Manufacturers:
 - a. Carlton Industries
 - b. Seton Identification
 - c. Or approved equal

- E. Underground-Line Warning Tape:
 1. Manufacturers:
 - a. Brady Corp.
 - b. Brimar Industries
 - c. Ideal Industries
 - d. Or approved equal
 2. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 3. Color and Printing:
 - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

- F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.06 CABLE TIES

- A. Manufacturers:
 1. HellermannTyton
 2. Ideal Industries
 3. Panduit Corp
 4. Or approved Equal

- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 4. Color: Black, except where used for color-coding.
- C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 12,000 psi (82.7 MPa).
 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 4. Color: Black.
- D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D 638: 7000 psi (48.2 MPa).
 3. UL 94 Flame Rating: 94V-0.
 4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
 5. Color: Black.

2.07 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain 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

3.01 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.02 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.

- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."
 - 3. "UPS."
- L. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- M. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.
- N. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- O. Self-Adhesive Labels:
 - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
- P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

- Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- V. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common exceeds 16 inches (400 mm) overall.
 - 2. Limit use of underground-line warning tape to direct-buried cables.
 - 3. Install underground-line warning tape for direct-buried cables and cables in raceways.
- W. Cable Ties: General purpose, for attaching tags, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.

3.03 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30A and 120V to Ground: Identify with self-adhesive raceway labels.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."

- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels to identify the phase.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
- F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.
- H. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- I. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- J. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- K. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- L. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- M. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
 - 1. Apply to exterior of door, cover, or other access.
 - 2. 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.
- N. Arc Flash Warning Labeling: Self-adhesive labels.
- O. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.
- P. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer. Coordinate "Equipment Identification Labels" Paragraph below with electrical Sections. Delete items not in Project.
- Q. Equipment Identification Labels:
 - 1. Indoor Equipment: Laminated acrylic or melamine plastic sign.

2. Outdoor Equipment: Laminated acrylic or melamine sign.
3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.
 - f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - g. Emergency system boxes and enclosures.
 - h. Enclosed switches.
 - i. Enclosed circuit breakers.
 - j. Enclosed controllers.
 - k. Variable-speed controllers.
 - l. Push-button stations.
 - m. Power-transfer equipment.
 - n. Contactors.
 - o. Remote-controlled switches, dimmer modules, and control devices.
 - p. Power-generating units.
 - q. Monitoring and control equipment.
 - r. UPS equipment.

END OF SECTION

**SECTION 26 27 26
WIRING DEVICES**

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Standard-grade receptacles, 125 V, 20 A.
 - 2. USB receptacles.
 - 3. GFCI receptacles, 125 V, 20 A.
 - 4. Twist-locking receptacles.
 - 5. Cord and plug sets.
 - 6. Toggle switches, 120/277 V, 20 A.
 - 7. Wall plates.

1.03 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. RFI: Radio-frequency interference.
- G. SPD: Surge protective device.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.

1.05 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.07 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.

PART 2 - PRODUCTS

2.01 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Comply with NFPA 70.
- C. RoHS compliant.
- D. Comply with NEMA WD 1.
- E. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- F. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: White unless otherwise indicated or required by NFPA 70 or device listing.
- G. Wall Plate Color: Stainless steel.
- H. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

- A. Duplex Receptacles, 125 V, 20 A:
 - 1. Manufacturers:
 - a. Eaton
 - b. Leviton
 - c. Hubbell

- d. Or approved equal.
- 2. Description: Two pole, three wire, and self-grounding.
- 3. Configuration: NEMA WD 6, Configuration 5-20R.
- 4. Standards: Comply with UL 498 and FS W-C-596.

B. Weather-Resistant Duplex Receptacle, 125 V, 20 A:

- 1. Manufacturers:
 - a. Eaton
 - b. Leviton
 - c. Hubbell
 - d. Or approved equal.
- 2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
- 3. Configuration: NEMA WD 6, Configuration 5-20R.
- 4. Standards: Comply with UL 498.
- 5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

2.03 USB RECEPTACLES

A. USB Charging Receptacles:

- 1. Manufacturers:
 - a. Eaton
 - b. Leviton
 - c. Hubbell
 - d. Or approved equal.
- 2. Description: Single piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
- 3. USB Receptacles: Dual, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
- 4. Standards: Comply with UL 1310 and USB 3.0 devices.

B. Tamper-Resistant Duplex and USB Charging Receptacles:

- 1. Manufacturers:
 - a. Eaton
 - b. Leviton
 - c. Hubbell
 - d. Or approved equal.
- 2. Description: Single piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.
- 3. Line Voltage Receptacles: Two pole, three wire, and self-grounding; NEMA WD 6, Configuration 5-20R.
- 4. USB Receptacles: Dual USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
- 5. Standards: Comply with UL 498, UL 1310, USB 3.0 devices, and FS W-C-596.
- 6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.04 GFCI RECEPTACLES, 125 V, 20 A

- 1. Manufacturers:

- a. Eaton
- b. Leviton
- c. Hubbell
- d. Or approved equal.
2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Non-feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

2.05 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Receptacles, 120 V, 20 A:

1. Manufacturers:
 - a. Eaton
 - b. Leviton
 - c. Hubbell
 - d. Or approved equal.
2. Configuration: NEMA WD 6, Configuration L5-20R.
3. Standards: Comply with UL 498.

B. Twist-Lock, Single Receptacles, 250 V, 20 A:

1. Manufacturers:
 - a. Eaton
 - b. Leviton
 - c. Hubbell
 - d. Or approved equal.
2. Configuration: NEMA WD 6, Configuration L6-20R.
3. Standards: Comply with UL 498.

C. Twist-Lock, Single Receptacles, 277 V, 20 A:

1. Manufacturers:
 - a. Eaton
 - b. Leviton
 - c. Hubbell
 - d. Or approved equal.
2. Configuration: NEMA WD 6, Configuration L7-20R.
3. Standards: Comply with UL 498.

2.06 CORD AND PLUG SETS

- A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
- B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
- C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.07 TOGGLE SWITCHES, 120/277 V, 20 A

- A. Single-Pole Switches, 120/277 V, 20 A:
 - 1. Manufacturers:
 - a. Eaton
 - b. Leviton
 - c. Hubbell
 - d. Or approved equal.
 - 2. Standards: Comply with UL 20 and FS W-S-896.
- B. Lighted Single-Pole Switches, 120/277 V, 20 A:
 - 1. Manufacturers:
 - a. Eaton
 - b. Leviton
 - c. Hubbell
 - d. Or approved equal.
 - 2. Description: Handle illuminated when switch is on.
 - 3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.
- C. Key-Operated, Single-Pole Switches, 120/277 V, 20 A:
 - 1. Manufacturers:
 - a. Eaton
 - b. Leviton
 - c. Hubbell
 - d. Or approved equal.
 - 2. Description: Factory-supplied key in lieu of switch handle.
 - 3. Standards: Comply with UL 20 and FS W-S-896.
- D. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A.
 - 1. Manufacturers:
 - a. Eaton
 - b. Leviton
 - c. Hubbell
 - d. Or approved equal.
 - 2. Description: For use with mechanically held lighting contactors.
 - 3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.
- E. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A:
 - 1. Manufacturers:
 - a. Eaton
 - b. Leviton
 - c. Hubbell
 - d. Or approved equal.
 - 2. Description: For use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
 - 3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.08 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel.
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover and listed and labeled for use in wet and damp locations.
- C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.
- D. Antimicrobial Cover Plates:
 - 1. Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
 - 2. Tarnish resistant.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. 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 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 right 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 comply with 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 devices that have been in temporary use during construction and that 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 (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by 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. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

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. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. 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, multi-gang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.02 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.03 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:
 - 1. In healthcare facilities, prepare reports that comply with NFPA 99.
 - 2. Test Instruments: Use instruments that comply with UL 1436.
 - 3. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 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. 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 ones, and retest as specified above.
- E. Wiring device will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION

**SECTION 26 28 13
FUSES**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section Includes:
 - 1. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Control circuits.
 - b. Enclosed controllers.
 - c. Enclosed switches.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, 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. Submit in PDF format.
 - 5. Coordination charts and tables and related data.
 - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.04 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017700 "Closeout Procedures," Section 017823 "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 used on the Project. Submit in PDF format.
4. Coordination charts and tables and related data.

1.05 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than 3 of each size and type.

1.06 FIELD 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.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers:
 1. Bussmann
 2. Littelfuse
 3. Or approved equal.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.02 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC.
 2. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC
 3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC
 4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC
 5. Type J: 600-V, zero- to 600-A rating, 200 kAIC
 6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC
 7. Type T: 600-V, zero- to 800-A rating, 200 kAIC
- B. 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.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.

- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.01 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.

3.02 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Feeders: Class L, fast acting.
 - 2. Motor Branch Circuits: Class RK1, time delay.
 - 3. Large Motor Branch (601-4000 A): Class L, time delay.
 - 4. Power Electronics Circuits: Class J, high speed.
 - 5. Other Branch Circuits: Class RK1, time delay.
 - 6. Control Transformer Circuits: Class CC, time delay, control transformer duty.
 - 7. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.03 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Architect.

3.04 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of 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

1.01 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.

1.02 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Non fusible switches.
 - 3. Receptacle switches.
 - 4. Molded-case circuit breakers (MCCBs).
 - 5. Molded-case switches.
 - 6. Enclosures.

1.03 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, 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 a nationally recognized testing laboratory (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. Provide in [PDF] [and] <Insert calculation program format> electronic format.
- B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Seismic Qualification Data: 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.
- C. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers 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. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - b. 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. Provide in PDF electronic format.

1.07 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.08 FIELD 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).

1.09 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers 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.

2.02 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. 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.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.03 FUSIBLE SWITCHES

- A. Manufacturers:
 - 1. ABB
 - 2. Eaton
 - 3. Siemens
 - 4. Or approved equal.
- B. Type HD, Heavy Duty:
 - 1. Single throw.
 - 2. Three pole.
 - 3. 600-V ac.
 - 4. 1200 A and smaller.
 - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
 - 6. 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, 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. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.04 NONFUSIBLE SWITCHES

A. Manufacturers:

1. ABB
2. Eaton
3. Siemens
4. Or approved equal.

B. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Three Pole, 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.

D. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 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.

E. Type HD, Heavy Duty, Three Pole, Double 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.

F. 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, 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. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.05 RECEPTACLE SWITCHES

A. Manufacturers:

1. ABB
2. Eaton

3. Siemens
 4. Or approved equal.
- B. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 240-V ac, 30 amperage A; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- C. Type HD, Heavy-Duty, Three Pole, Single-Throw Non fusible Switch: 600-V ac, 30 amperage A; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. 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.
- E. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).
- F. 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, 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. Lugs: Mechanical type, suitable for number, size, and conductor material.
 6. Service-Rated Switches: Labeled for use as service equipment.

2.06 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers:
1. ABB
 2. Eaton
 3. Siemens
 4. Or approved equal.
- B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- D. MCCBs shall be equipped with a device for locking in the isolated position.

- E. Lugs shall be suitable sized according to the 167 deg F (75 deg C) temperature rating in NFPA 70.
- F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal 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.
- H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- I. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, 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-squared t response.
- J. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- K. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- L. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- M. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- N. 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.
 - 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.

2.07 MOLDED-CASE SWITCHES

- A. Manufacturers:
 - 1. ABB
 - 2. Eaton
 - 3. Siemens

4. Or approved equal.
- B. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- D. Features and Accessories:
 1. Standard frame sizes and number of poles.
 2. Lugs:
 - a. Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - b. Lugs shall be suitable sized according to the 167 deg F (75 deg C) temperature rating in NFPA 70.
 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.

2.08 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both end walls.
- D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure to override the interlock.
- E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.
- F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.01 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.
 - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.02 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Architect no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Architect's written permission.
 - 4. Comply with NFPA 70E.

3.03 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Other Wet or Damp, Indoor Locations: NEMA 250, [Type 4] <Insert type>.
 - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.04 INSTALLATION

- 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.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices.

- F. Comply with NFPA 70 and NECA 1.

3.05 IDENTIFICATION

- A. Comply with requirements in Section 260553 "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.

3.06 FIELD QUALITY CONTROL

- A. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
 - 2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Measure contact resistance across each switchblade fuse holder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate

from adjacent poles or similar switches by more than 50 percent of the lowest value.

- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
- e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

B. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that the unit is clean.
- e. Operate the circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.
- h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate

values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 4. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.
1. Test procedures used.
 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.07 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

END OF SECTION