

TOWN OF WEST WARWICK
REQUEST FOR PROPOSALS (RFP)

GENERAL CONTRACTOR
30 Payan Street Renovation

ADDENDUM #2
Posted 2/12/2026



RFQ/P REFERENCE NUMBER: 2026-08
RFP RELEASE DATE: January 27, 2026

SEALED PROPOSALS MUST BE SUBMITTED BY
Tuesday, February 17, 2026 – 10:00 AM

RFQ/P Issued by:
Town of West Warwick

Mark Knott
Town Manager

ATTACHMENTS:

APPENDIX A: RFI Log – 2/12/2026

LINK: [APPENDIX A - RFI Log](#)

https://netorg856529-my.sharepoint.com/:f:/g/personal/kturner_leftfieldpm_com/IgBXTtkgSWgHSoLZWpMwHU7IAXfIZWNqASde2XEW2AhjW90?e=Psq8Ln

APPENDIX B: Tecton Architects – Addendum #2 Attachments

LINK: [APPENDIX B - Tecton Addendum 2](#)

https://netorg856529-my.sharepoint.com/:f:/g/personal/kturner_leftfieldpm_com/IgAbbo mKELZ3QoliJ7eLirYtAS1PCGZOVvv6WuL_CKEGvIU?e=XLrfKk

APPENDIX C: AIA A201-2017

LINK: [APPENDIX C - AIA A201-2017](#)

https://netorg856529-my.sharepoint.com/:f:/g/personal/kturner_leftfieldpm_com/IgBvOH4vFRDWT6yr6ULNvwi_AXJ8NokKhEdStqYoWVAMDFQ?e=pT2m8A

APPENDIX D: Revised Bid Form

LINK: [APPENDIX D - Bid Form](#)

https://netorg856529-my.sharepoint.com/:f:/g/personal/kturner_leftfieldpm_com/IgDX3Pd6m2_QR54shXnEmW7CAS937FnMAv-_xx89g3AQYK8?e=t5Wg5z

Town of West Warwick
RFI Log
30 Payan Street Renovation
2/12/2016

RFI #	RFI Description	Request Date	Dwg/Spec Ref.	RFI Response	Response Date	
	GENERAL:					
G-01	Bid duration is very tight & as is will only leave subcontractors to have about 1.5 weeks to bid. Can this be extended 1 week?	1/29/2026		Bid due date remains at 2/17/2026	2/2/2026	
G-02	There are no prevailing wage rate sheets. Please provide so there is no confusion with differing rates needing to be utilized.	1/29/2026	Prevailing Wage Sheets	Utilize state prevailing wage sheets for the Town of West Warwick/Kent County: https://sam.gov/wage-determination/RI20260001/2 All requirements for prevailing wage must be met and documentation provided by the contractor	2/10/2026	
RIGL § 37-13 State, Municipal, & Quasi Prevailing Wage Construction Projects						
Contract Values	Payment of Prevailing Wage (RIGL § 37-13-3 and RIGL § 37-13-7)	RI Certified Monthly Payroll (RIGL§ 37-13-13)	Health Insurance Requirement (RIGL § 37-13-7[b](2)(ii) (A), exemptions apply to employees already insured by relationship or employment of 90 days or less)	OSHA-10 Certification (RIGL § 37-23-6)	RI Certified PW Daily Log (RIGL§ 37-13-13(c))	Registered Apprenticeship Program (RIGL § 37-13-3.1)
Over \$1,000.00	x	x	x	Not required.	Not required.	Not required.
Over \$100,000.00	x	x	x	x	Not required.	Not required.
Over \$1,000,000.00	x	x	x	x	x (both monthly payroll and daily log of employees for public works other than road, highway or bridge)	x *Only Applies to State Prevailing Wage Projects*
G-03	Appendix F AIA A201-2016 General Condition is not part of the documents - please provide.	1/29/2026	Appendix F	Provided in Addendum 2	2/10/2026	
G-04	Could another site walk-thru be provided if subcontractors need to see the interiors?	1/29/2026		Final site visit can be accommodated 2/12/2026 at 9am	2/10/2026	
G-05	Alternates are shown on I2.10 but they are not on the bid form. What is the method to depict these alternate adds or deducts in our bids?	1/29/2026	I2.10	Bid form updated in Addendum #2	2/10/2026	
G-06	Electrical Unit Prices are requested on E0.01 but they are not on the bid form. What is the method to depict these unit prices in our bids?	1/29/2026	E0.01	Bid form updated in Addendum #2	2/10/2026	
G-07	Please confirm if building permit is by owner or GC. Either way, should it be assumed the State ADA fee still applies?	1/29/2026	Permit	Building permit is by GC. State ADA fee applies	2/10/2026	
G-08	Per the walk-thru, confirm the building will be un-occupied.	1/29/2026		Confirmed	2/10/2026	
G-09	Per the walk-thru, confirm the GC does not need to include a bid bond.	1/29/2026	Bid Bond	Confirmed	2/10/2026	
G-10	Per the walk-thru, confirm the GC does need to include builders risk insurance.	1/29/2026	Bldr's Risk Insurance	Confirmed	2/10/2026	

Town of West Warwick
RFI Log
30 Payan Street Renovation
2/12/2016

G-11	Documents mention LD's (liquidated damages) but do not mention amount - please provide costs to be assessed.	1/29/2026	LD's	Liquidated damages are not included as part of this contract. However, please reference section 6.2.3 of the AIA A201-2017 contract as it relates to contractor responsibility for costs incurred payable to a separate contractor because of the Contractor's delay	2/10/2026
G-12	Please provide the walk-thru sign-in sheet	1/29/2026		Provided in Addendum 1	2/2/2026
G-13	General – Can there be a 2 nd day(s?) & time(s?) for subs to walk through the building?	2/9/2026		Final site visit can be accommodated 2/12/2026 at 9am	2/10/2026
G-14	Please confirm if the electrical power / utility usage will be paid for by the owner during construction.	2/10/2026		Confirmed	2/10/2026
G-15	All drawings, specs, RFP, ... docs say 30 Payan Street. The number over the front door is 28. See attached photo. (Google maps has 30.) Will the town employees be changing this to #30?	2/10/2026		The address of the building is 30 Payan Street	2/10/2026
	SITE / CIVIL:				
C-01	Is the fencing scope on the North East (upper left on drawing L1.00) just 2 gates & no 'fixed' fence on either side of these 2 gates? Please provide the height of the fence and a specification for this fence (assumed a commercial grade and maybe vinyl coated chain link?) Please clarify.	2/2/2026	L1.00	New fence at basketball court play area is to be 64' long by 4' high, black coated chain link fence with (2) 16' manually operated rolling gates.	2/11/2026
C-02	Please confirm drawing C.00 has no demolition (as titled) on it; only existing conditions. Site demo seems to be called out on drawing L1.00.	2/9/2026	C.00	Correct, minor demolition items are indicated on L1.00.	2/11/2026
	LANDSCAPE:				
L-01	Drawing L 1.00 - Please confirm metal benches are furnished and installed by owner. No "provide" by GC. Please confirm striping, stop sign, and movable hoop & backboard are all by the town of West Warwick.	2/9/2026	L1.00	Exterior bench seating is provided by Owner. All exterior line striping and equipment is by Owner.	2/11/2026
L-02	Please provide details/elevations & specifications for exterior basketball court/markings including dimensions.	2/6/2026		Exterior basketball court line striping is by Owner.	2/11/2026
L-03	Please provide details and specifications for exterior basketball backboard.	2/6/2026		Movable basketball hoop is by Owner.	2/11/2026
L-04	Please provide details and elevations including specifications for exterior manual operated fence/gate.	2/6/2026		New fence at basketball court play area is to be 64' long by 4' high, black coated chain link fence with (2) 16' manually operated rolling gates.	2/11/2026
L-05	Please confirm that the exterior "painted stop bar painted sign" are by owner.	2/6/2026		All exterior line striping is by Owner.	2/11/2026

Town of West Warwick
RFI Log
30 Payan Street Renovation
2/12/2016

L-06	Please provide specifications and anticipated square footage to be loamed & seeded.	2/6/2026		Extent of loam and seed areas are associated with the existing playscapes and play surfacing as indicated on L1.00. Assume depth of surfacing to be removed is 4" and replaced with loam and perennial ryegrass seed mixture.	2/11/2026
	ARCHITECTURAL:				
A-01	Demo drawings & Plumbing drawings are not coordinated for slab removal & patching. Which drawings are we to use? Will the demo drawings be updated to show all required removals & patching based on existing piping to be removed back to main?	1/29/2026	A1.10 & PD1.01	P1.00 indicates extent of new underslab piping and is to be used for extent of floor slab sawcutting and patching.	2/11/2026
A-02	Drawing I2.10 call out Glazing Films WF-1 & WF-2. Please confirm if either of these will be needed on project. [Walk-Thru comment may suggest not required.]	1/29/2026	I2.10	Delete WF-1 and WF-2 from project, per Owner no window film is required.	2/11/2026
A-03	Appliance Schedule on A6.10 shows EQ-1 thru EQ-3 to be furnished & installed by owner. These appear to be the refrigerator, microwave & coffee maker. Can it be assumed the dishwasher will also be by owner?	2/2/2026	A6.10	Yes, all residential equipment to be provided by Owner.	2/11/2026
A-04	Door 200 is missing the hardware set #, please provide.	2/5/2026	A8.10	Door 200 to receive HW Set #4.	2/11/2026
A-05	Door Hardware Spec 08710 (section 3.8,B) refers to spec section 080671 to see door hardware sets. Drawing A8.10 shows hardware set but information is very limited. Please provide the 080671 spec and a full hardware set with all information to price accurately.	2/5/2026	A8.10, 087100 & 080671	Drawings indicate type of hardware for each set, specifications indicate products.	2/11/2026
A-06	What is the finish on the hardware sets? This is not shown on drawings or noted in spec's. Please provide.	2/5/2026	A8.10 & 087100	Assume brushed nickel finish for hardware trim.	2/11/2026
A-07	If a cabinet company is an AWI member and follow all AWI Specifications, but were not part of the AWI/QCP Program, could they still bid on this? Can the QCP program requirement be waived? (refer to 064023 page 2)	2/5/2026	064023	QCP program requirement can be waived for this project.	2/11/2026
A-08	Drawing I2.10 call out both P-Lam & Solid Surface for counters but floor plans & details/elevation drawings do not confirm either. What will be the countertop materials for Break & Nurse?	2/9/2026	A2.10 & I2.10	Per Owner's direction, countertop material for Break Room and Nurse area is to be granite.	2/11/2026
A-09	Spec section 101400 is Signage, however, there is nothing shown on any drawing or scheduled in the spec. - Can we assume this will be by owner?	2/9/2026	101400	Assume one sign per interior door.	2/11/2026
A-10	Exterior Painting - Is the only exterior painting for the new window trim, new fascia behind the new gutter & just the patched siding locations only where wall was infilled at removed exhaust fan?	2/9/2026	A4.10	Correct.	2/11/2026

Town of West Warwick
RFI Log
30 Payan Street Renovation
2/12/2016

A-11	Drawing I2.10 in the SS-1 Solid Surface notes mentions All new Counters, Window Sills where applicable. When walking the building, there were no locations seen for window sills. Assuming window sill are not to be included? (sill widths were very narrow at about 1-1/2" to maybe 2" wide)	2/9/2026	I2.10	All window sills will be drywall.	2/11/2026
A-12	Will there be downspouts on this project? None are shown on drawings A4.10 nor A2.30	2/10/2026	A4.10/A2.30	All existing downspouts and gutters are to remain.	2/11/2026
A-13	Specification section 07 71 00 lists materials for gutters & downspouts, but drawings A2.30 and A4.10 don't have any called for.	2/10/2026	A4.10/A2.30	All existing downspouts and gutters are to remain.	2/11/2026
A-14	Drawing A2.30 has what seems to possibly be gutters drawn in most areas, but not called out. If they are gutters, it looks like none are over the roof extensions at the HVAC units, at the (2) side exits nor at the rear mid-level hip roof. Details F12 & K12 show gutters on the existing building. Will there be new gutters on this renovated building?	2/10/2026	A4.10/A2.30	All existing downspouts and gutters are to remain.	2/11/2026
A-15	Please identify AWP-1 on the drawings as identified in spec section 09 84 36.	2/9/2026	09 84 36.	There is no AWP-1 on the project, disregard specification section.	2/11/2026
A-16	Please clarify the word "INTEGRAL" as shown on the finish schedule in association with rooms with WP-3.	2/9/2026		"Integral" means that the wall protection is contiguous to the wall base, therefore there is no distinct material to identify for the wall base on the material schedule, as it is integral to the wall assembly.	2/11/2026
A-17	Please provide detail of the mounting for FAB-1 as shown but not detailed on drawing A3.10.	2/9/2026	A3.10	Curtain track to mount directly to ceiling grid, which is able to be accommodated by basis of design product.	2/11/2026
A-18	The factory rep for the Folding Partition (Hufcor) will not provide pricing for the folding partition. He says the doors as shown will not "stack or be functional" for the end user. He also states that the spec calls highest rated sound rating the industry offers and questions if this folding partition specification is correct in this application/project. The supporting Truss (2.02) spec does not match the drawings, and it calls for a "Pass-Door" that is not shown on the drawing, nor do they offer a "delegated design option" as noted in the specifications. Please advise.	2/9/2026		Manufacturer for the Folding partition is replaced with "Kwik-wall". Refer to Unispan System by Kirk-wall.	2/11/2026
A-19	Drawing A0.20 - What is the low wall type-H pony-wall-stud maximum spacing?	2/9/2026	A0.20	16" OC.	2/11/2026
A-20	Drawing A1.10 - Please confirm that more floor demo in the corridors will be required than shown on PD 1.01 if actual plumbing connections are as shown on drawing P 1.00.	2/9/2026	A1.10 & PD1.01	P1.00 indicates extent of new underslab piping and is to be used for extent of floor slab sawcutting and patching.	2/11/2026
A-21	Drawing A2.10 - What are the wall types/infills between corridor 116 and rooms 113, 114, 118.1 & 118.2? What are the wall types/infills between corridor 121 and rooms 124.1, 124.2, 127 and 128?	2/9/2026	A2.10	Wall infills are to meet the width and assembly of "Existing Interior Partion" with F2 furring.	2/11/2026

Town of West Warwick
RFI Log
30 Payan Street Renovation
2/12/2016

A-22	Drawing A3.10 - RS-1 roller shades are not noted or shown for three windows in rooms 102, 109, 125 or 126; is this on purpose? RS-1 on drawing I2.10 calls for them at all exterior windows.	2/9/2026	A3.10	Provide RS-1 roller shades at these 4 rooms.	2/11/2026
A-23	Drawing A6.10 - Appliances EQ-1, 2 and 3: #1 REF and #2 (looks like a MW) are called out in specs 11 31 00 along with a DW; are there two of these? Are these all furnished by owner or GC?	2/9/2026	A6.10	All residential equipment to be provided by Owner.	2/11/2026
A-24	Drawing I2.10 - Alternates shown on this drawing are not listed on the bid form?	2/9/2026	I2.10	Refer to revised Bid Form issued via addenda for Project Alternates.	2/11/2026
A-25	Drawing I2.10 - Flooring type RT is noted on the plan near the stairs - are these type RT-1 &/or type RT-2.	2/9/2026	I2.10	RT-1 as indicated on I2.10	2/11/2026
A-26	Drawing I2.10 - Plan D12: please confirm there should be five (5) CG-1 tags for CG's shown, but not called out, similar to plan K12	2/9/2026	I2.10	Corner guards are limited to Lobby and Corridor locations as indicated on I2.10.	2/11/2026
A-27	Drawing I2.10 - Please confirm all the locations for WF-1 and WF-2.	2/9/2026	I2.10	Delete WF-1 and WF-2 from project, per Owner no window film is required.	2/11/2026
A-28	Hardware Set 03: specifies Surface Vertical Rod Exit Devices and No Elect Hardware. Openings 101.1, 101.2 are single doors and have "Card Reader" in the Remarks column of the Door Schedule. Do you want me to carry a Rim Exit and an Elec Strike for this Set or an EPT + Elect Rim Panic?	2/9/2026		Card readers are located at doors 100.1, 100.2, 100.3, 101.1, 101.2, 106.1, 116, 120, 121, and 200. Provide electrified hardware at all card reader locations. Provide electrified rim exit devices at 100.1, 100.2, 101.1, 101.2, 116, 120, and 121. Provide mechanical rim exit device at S1A.	2/11/2026
A-29	Hardware Set 05: is for Pairs of Vestibule Doors (100.1, 100.2 By Others) but is also assigned to Single Opening 100.3. 100.3 also has "Card Reader" in the Remarks column of the Door Schedule. Can you please advise what hardware they want for Opening 100.3?	2/9/2026		Door 100.3 to be electrified office lockset.	2/11/2026
A-30	Hardware Set 07: specifies a Continuous Hinge w/EPT prep and a Power Supply but also an Intruder Lock, which is not Electrified. Openings 116, 121, S1A have "Card Reader" in the Remarks column of the Door Schedule. Do you want me to carry an Elect Lock in this Hardware Set?	2/9/2026		1. HW Set 7 are the two exterior corridor egress doors. No intruder lock, electrified rim egress device. 2. Card readers are at 116 and 121, not S1A. Provide electrified hardware at all card reader locations (Doors 100.1, 100.2, 100.3, 101.1, 101.2, 106.1, 116, 120, 121, and 200).	2/11/2026
A-31	I also am not carrying anything for the Openings on the "Existing" Door Schedule and Excluding Hdwr Set 06. Is this okay?	2/9/2026		Door HW 6 is intended for existing doors to remain, provide new lockset and key core in existing door.	2/11/2026

Town of West Warwick
RFI Log
30 Payan Street Renovation
2/12/2016

A-32	I don't see Opening 200 on the Floor Plan and there is No Hardware assigned to it on the Door Schedule.	2/9/2026		Door 200 is the Second Floor at IDF Room, new double door with card reader access. Double doors to have inactive leaf with flush bolts in new frame, active leaf to be HW Set 6 cylindrical electrified lock.	2/11/2026
A-33	E. "Sign Schedule: Use same designations indicated on Drawings" Does that mean there is a published sign schedule somewhere in the drawings with all specs for each type/copy ? Could not find it.	2/9/2026	Part 1; 1.04	Assume one sign per interior door.	2/11/2026
A-34	C. changeable message insert signs- how many? D. Interior Emergency Exit Maps- "Provide one map per occupied space, as indicated". Indicated where? Also, are we correct that we would supply the map HOLDERS only at 9.5" H X 12" W for paper map inserts (by others)? That is what we typically provide.	2/9/2026	Part 2; 2.01	C. Paper inserts will be the responsibility of the Owner. D. Locations to be at each occupied room door. Owner will supply paper egress maps at each location, contractor is responsible holder.	2/11/2026
A-35	We typically do not provide the paper inserts- customer's responsibility. Is that OK?	2/9/2026	2.03 B.1.	Yes, paper inserts will be the responsibility of the Owner.	2/11/2026
A-36	Please explain why Wall Protection (WP-3) is not in specification section 10 26 00 for Wall Protection?	2/9/2026	10 26 00	WP-3 is identified on I2.10 as Gold Medal Safety Padding, 1 1/2" thick, color tan, mounted 0'-0" AFF to 8'-0" AFF.	2/11/2026
A-37	Why is FRP Wall Panels included in specification 10 26 00?	2/9/2026	10 26 00	Disregard section 2.04 of section 10 26 00, as it is not located within the project scope.	2/11/2026
A-38	Please clarify demo Note 8 as the bidders are only responsible for items clearly identified on the drawings.	2/5/2026		Note 8 clarifies that where an element is removed, all associated material located on or attached to element is also to be removed.	2/11/2026
A-39	Please clarify demo Note 9 & identify if there is any area that requires structural shoring.	2/5/2026		Interior structural bearing walls are limited to the corridor walls. Temporary protection is the responsibility of the contractor in coordination with openings within the existing walls.	2/11/2026
A-40	Please clarify the extent of removal of demo Note 14 for removals, as there is nothing identified for removal. All items should be clearly identified for accurate and competitive pricing.	2/5/2026		Extent of millwork demolition is indicated on drawing A1.10 via dashed lines.	2/11/2026
A-41	Please confirm that are no roof penetrations as none are shown.	2/5/2026		No roof penetrations are required.	2/11/2026
A-42	Please confirm the Dish Washer in the Residential Appliances specification? The model number reflects a washing machine.	2/5/2026		The owner will provide the dishwasher, so the specification can be disregarded. Please note that the contractor shall verify the counter height in field for the dishwasher.	2/10/2026
A-43	Please confirm that the glazing film has been deleted from the scope of work	2/5/2026		Remove WF-1 and WF-2 from project, no window film is required.	2/10/2026

Town of West Warwick
RFI Log
30 Payan Street Renovation
2/12/2016

A-44	Please provide location of visual display surfaces on the drawings. Upon identification is wood blocking required?	2/5/2026		Visual displays (TV) are located on typical classroom interior elevation K12/A6.10 for mounting height, and identified at locations indicated on Floor Plan A2.10. Contractor to provide blocking at these locations.	2/10/2026
A-45	Specified microwave has been discontinued, please provide alternate	2/5/2026		Microwave is owner provided so the specifications can be discarded.	2/10/2026
A-46	Drawing A6.11, Elevation D10 calls for WP-2, Design #2. Is this supposed to be WP-1, Design #2? If not, what are the specs for WP-2, Design #2, and is there a location for WP-1, Design #2	2/10/2026	A6.11	All wall graphics indicated on A6.11 to be WP-1, with unique graphics as indicated on I2.10.	2/11/2026
A-47	For a project of this size, are we able to waive the QCP certification and labelling? We see this spec'd a lot, it often gets waived because not a lot of companies are part of that program and those who do have it drive the cost up.	2/10/2026		QCP program requirement can be waived for this project.	2/11/2026
A-48	Dwg I2.10 Calls WP-3 being Gold Medal Safety Pads, yet the specifications call out Porter Athletics Super Safe Pads. Gold Medal pads are very expensive, please indicate which spec takes precedence.	2/10/2026	I2.10	Gold Medal is basis of design, Porter Athletics Super Safe Pads is the subject of a project alternate reflected in updated bid form.	2/11/2026
A-49	Signage: Part 1, 1.04, E - "Sign Schedule: Use some designations indicated on Drawings". Doesn't look like there's a sign schedule in the drawings. Part 2, 2.01, C - changeable message insert signs- how many? Part 2, 2.01, D. Interior Emergency Exit Maps- "Provide one map per occupied space, as indicated". Doesn't look like these are tagged on plans.	2/10/2026		Assume one sign per interior door. Paper inserts will be the responsibility of the Owner. Interior Emergency Exit Map locations to be at each occupied room door. Owner will supply paper egress maps at each location, contractor is responsible holder.	2/11/2026
A-50	Part 3, 3.02, B, 2 & 3 - VHB tape backed- which signs mount to glass? We suggest a piece of matching color vinyl on the reverse side of the glass. Is that OK?	2/10/2026		There are no areas in the project where this condition exists, disregard.	2/11/2026
A-51	Please confirm window sills are solid surface, and confirm the spec used.	2/10/2026		Window sills are to be gypsum wallboard returns.	2/11/2026
A-52	Which manufacturer/product should we be using for the storefront on A8.10?	2/10/2026		Basis of design is EFCO System S-433T, approved equals are Kawneer Trifab VG 451T and Oldcastle Series 3000.	2/11/2026
A-53	For the laminated glass, is this just regular or will it be School Guard with a special interlayer for added protection?	2/10/2026		Laminated Security Glass is Childguard or School Guard per Section 2.03 of specification 08 80 00.	2/11/2026
A-54	Hardware /Roto operators and lift locks won't fit on operable aluminum windows they are too narrow, please advise.	2/10/2026		Provide manufacturer's standard operable trim.	2/11/2026
A-55	Will insect screens be required?	2/10/2026		Insect screens are required at each operable opening.	2/11/2026

Town of West Warwick
RFI Log
30 Payan Street Renovation
2/12/2016

A-56	088000 Glazing Spec 3.08 and 3.09 references a U-Factor of .24 max which would require triple glazed insulated glass units. Please confirm if the makeup will stay at 1" double glaze or change to 1 1/2" triple glaze units	2/10/2026			2/11/2026
A-57	Per Spec 08 51 13, 2.01, A, the basis of design is calling for EFCO; X-Therm 325G but the "G" Stands for Grid and that's not shown on the drawings. Please confirm if grids are required for the windows	2/10/2026		1" Double Glazing is acceptable.	2/11/2026
	STRUCTURAL:				
S-01					
	MEP'S:				
M-01	Who is the current controls vendor? Will we need to utilize that vendor & what current manufacturer is used for the existing controls?	1/29/2026	KR: Reference spec 230900 2.01;II;1,2	KR: Current controls manufacturer is Distech indicated in 230900 2.01;II;1,2. Utilize Schools standard vendor.	2/10/2026
M-02	Please provide contact information for the HVAC controls vendor. Only reference is as follows: II. 2.02 A. B. C. Acceptable Manufacturers 1. 2. Subject to compliance with requirements, all controllers and workstation software shall be manufactured by: a. Distech Controls Building control system shall tie into and fully integrate into the West Warwick School District's existing Distech control system without the use of integration, conversion software, etc.	2/10/2026		KR: The schools standard controls vendor is: Nexgen Mechanical Dave McCurry 401-230-3955	2/11/2026
P-01	Plumbing - What is the depth of the existing sewer system to be tied into inside the building?	2/9/2026	KR: Reference drawing P1.00	KR: Existing sanitary invert is unknown. Contractor scoping of below ground sanitary piping is indicated in drawing.	2/10/2026
T-01	Who is responsible for providing the network switches?	2/9/2026	KR: Reference spec 275313, 2.01	KR: Provide Atlas Globalcom server to support all Atlas PA devices.	2/11/2026
T-02	2. The specs do not include any server for the Atlas PA devices (ie Atlas Globalcom or Informacast Fusion). Are these devices integrating into an existing district system so this isn't required?	2/9/2026	KR: Reference spec 275313, 2.01	KR: Provide Atlas Globalcom server to support all Atlas PA devices.	2/11/2026
T-03	In lieu of a responsibility matrix - Please confirm if owner or the electrical contractor is to include 'head-end' equipment for the Security / Access control / Video surveillance / Intrusion system(s).	2/10/2026	KR: Reference specs 28 13 00, 28 14 00, 28 15 00, 28 15 23, 28 20 00, 28 31 00	KR: All head-end equipment specified in the construction document/specifications shall be furnished and installed by the security contractor.	2/11/2026

Town of West Warwick
RFI Log
30 Payan Street Renovation
2/12/2016

FP-01	Fire Alarm a. Is this a new system or a modification to an old one (Model and Make)? saying to reconnect and extend as required - Lobby on E1.01 shows existing , E4.02 shows new	2/9/2026	KR: Reference drawings ED 1.01 E1.01 E4.02	KR: There shall be a new fire alarm system provided. Per drawing ED1.01 demolition key notes 7 and 8, disconnect and remove the existing fire alarm system, and retain the existing power conduit and wire for future use. Per the note on drawing E1.01, the new fire alarm control panel shall be connected to the existing power conduit and wire. All fire alarm conductors and devices shall be new.	2/11/2026
FP-02	b. According to M5.01, there is existing equipment on the roof- 4 RTU's, and AC-1. Will they require fan shutdown, and duct smokes?	2/9/2026	KR: Reference drawing E0.01 and all M-Series drawings	KR: Per note Other Trades Equipment Wiring note #8 on drawing E0.01, refer to M-Series documents for all duct smoke detector locations. Duct smokes indicated on M0.02. Yes, shutdown required.	2/11/2026
FP-03	c. Is there an existing document box, knox box, and masterbox/ antenna (make and model) ?	2/9/2026	KR: Reference drawings ED 1.01 E1.01	KR: There is an existing gamewell box located outside the building next to the main entrance doors; however, it shall be disconnected and removed. Provide new radio alarm transmitter as noted on construction documents.	2/11/2026
FP-04	d. How many sprinkler tamper and flows for the wet and dry systems are there? How many compressors are there? Where are they on the print?	2/9/2026	KR: Reference drawing E1.01	KR: There are (2) existing pressure switches, (1) existing flow switch, and (5) existing tamper switches. Refer to forthcoming addendum 2 drawing E1.01. Provide new fire alarm monitoring modules for all existing tamper, flow, and pressure switches identified, and connect to new fire alarm system.	2/10/2026
FP-05	Please confirm if an Edwards Fire Alarm system would be considered for the fire alarm system?	2/10/2026		KR: Bid as specified.	2/11/2026
FP-06	Who is existing fire alarm vendor for the building?	2/10/2026		KR: The existing fire alarm system is manufactured by Honeywell Fire-Lite. Note that the existing system shall be removed in its entirety and a new voice evacuation fire alarm system shall be provided.	2/11/2026
E-01	2 – I am requesting an additional walk thru to be granted? E0.01, note 23.	2/9/2026	E0.01	Final site visit can be accommodated 2/12/2026 at 9am	2/10/2026
E-02	3 – Is there asbestos in the existing conditions? We will be running surface conduit and hole sawing thru walls.	2/9/2026		Hazardous material survey will be provided by end of March 2026	2/2/2026
E-03	4 – What hazardous materials are they talking about? E0.01 Note 13	2/9/2026	KR: Reference drawing E0.01 Note 13	KR: If there are any hazardous materials, they shall be properly disposed of as noted on note 13 on drawing E0.01.	2/11/2026
E-04	5 – Patching and painting of demolition and new work electrical equipment is not under division 26, 27, 28 - E0.01, note 20	2/9/2026	KR: Reference drawing E0.01 Note 20	KR: Provide cutting and patching per drawing E0.01 demolition note 20.	2/11/2026

ADDENDUM 2

WEST WARWICK PUBLIC SCHOOLS – 30 PAYAN ST

30 Payan Street, West Warwick, RI 02893

Tecton Project No. WWE02AR

TO: Plan Holders

Project: 30 PAYAN ST

Project #: WWE02AR

Owner: West Warwick Public Schools

Date: February 11, 2026

Notice is hereby given that this Addendum forms a part of the Contract Documents and modifies the original Contract Documents as noted below.

A. SPECIFICATIONS

1. 21 05 00 COMMON WORK RESULTS FOR FIRE SUPPRESSION
 - General commissioning requirements added.
2. 21 13 13 WET-PIPE SPRINKLER SYSTEMS
 - Removed backflow preventers from Section 2.04.
3. 22 05 00 COMMON WORK RESULTS FOR PLUMBING
 - General commissioning requirements added.
4. 22 11 19 DOMESTIC WATER PIPING SPECIALTIES
 - Added verbiage for backflow preventer testing.
5. 23 00 00 GENERAL PROVISIONS
 - General commissioning requirements added.
6. 23 05 29 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
 - General commissioning requirements added.
7. 23 05 48 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
 - General commissioning requirements added.
8. 23 05 53 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
 - General commissioning requirements added.
9. 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC
 - General commissioning requirements added.
10. 23 07 00 HVAC INSULATION
 - General commissioning requirements added.

WEST WARWICK PUBLIC SCHOOLS – 30 PAYAN ST**30 Payan Street, West Warwick, RI 02893**

Tecton Project No. WWE02AR

11. 23 09 93 SEQUENCE OF OPERATIONS FOR HVAC, PLUMBING, AND ELECTRICAL CONTROLS
 - Clarified CO control levels in Section 1.18.
 - Clarified CO control levels in Section 1.19.
 - Clarified ambient gas levels in Section 1.20.
12. 23 23 00 REFRIGERANT PIPING
 - General commissioning requirements added.
13. 23 33 00 AIR DUCT ACCESSORIES
 - General commissioning requirements added.
14. 23 34 23 HVAC POWER VENTILATORS
 - General commissioning requirements added.
15. 23 36 00 AIR TERMINAL UNITS
 - General commissioning requirements added.
16. 23 37 13 DIFFUSERS, REGISTERS, AND GRILLES
 - General commissioning requirements added.
17. 26 01 00 GENERAL ELECTRICAL REQUIREMENTS
 - General commissioning requirements added.
18. 26 27 26 WIRING DEVICES
 - General commissioning requirements added.
19. 27 08 00 COMMISSIONING OF COMMUNICATIONS
 - General commissioning requirements added.
20. 28 10 00 ACCESS CONTROL
 - General commissioning requirements added.
21. 28 15 00 INTEGRATED ACCESS CONTROL HARDWARE DEVICES
 - General commissioning requirements added.
22. 28 31 11 DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM
 - Manufacturer clarified for radio alarm transmitter.

B. Drawings

1. A1.10 DEMOLITION FLOOR PLANS
 - Coordinated slab cut with plumbing and electrical drawings per RFI A-01.
 - Added typical demolition notes for corridors, classrooms, and toilets per RFI A-40.
2. A1.11 DEMOLITION ROOF PLAN
 - Revised the demolition note to remove requirement for removal for that all gutters and downspouts as they are existing to remain per RFI A-12.
3. A1.30 DEMOLITION EXTERIOR ELEVATIONS

- Revised the demolition note to remove requirement for removal for that all gutters and downspouts as they are existing to remain per RFI A-12.
4. A2.10 MAIN LEVEL FLOOR PLAN, SECTIONS, & DETAILS
 - Coordinated slab infill with plumbing and electrical drawings per RFI A-01.
 5. A2.30 ROOF PLAN & ROOF DETAILS
 - Added a note on drawing F12 to indicate that all gutters are to remain existing per RFI A-14.
 6. A3.10 REFLECTED CEILING PLANS & DETAILS
 - Updated the reflected ceiling plan to include window and roller shade tagging for rooms 102, 109, 125, and 126 per RFI A-21.
 7. A6.10 ENLARGED PLANS & ELEVATIONS
 - Revised the appliance schedule and updated dishwasher tagging on G10 to indicate the dishwasher will be owner-provided per RFI A-03.
 8. A7.20 CASEWORK DETAILS
 - Revised counter surface detail to show granite counter per RFI A-08.
 9. A8.10 DOOR & WINDOW SCHEDULES, ELEVATIONS AND DETAILS
 - Added door hardware set #04 to door# 200 per RFI A-04.
 - Added a general note for electrified hardware at all card reader locations per RFI A-28.
 - Added a general note for HW set 06 at all existing doors to remain per RFI A-31.
 - Modified door schedule to indicate electrified and mechanical rim exit devices on doors #100.1, 100.2, 101.1, 101.2, 116, 120, 121, and S1A per RFI A-28.
 - Modified door schedule to indicate electrified office lockset for door #100.3 per RFI A-29.
 - Modified door schedule to indicate cylindrical electrified lock for door #200 per RFI A-32.
 - Modified windowsill from solid surface to gypsum board return per RFI A-11.
 - Added storefront jamb detail at D7 and head detail at D9 for existing interior partition wall.
 - Added storefront jamb detail at F8 and head detail at F10 for existing exterior wall.
 - Referenced storefront jamb and head details at SF1 and SF2.
 10. I2.10 FINISHED PLANS & MATERIALS LIST
 - Removed window glazing films WF-1 and WF-2 per RFI A-27.
 - Modified Solid Surface SS-1 to be applicable for wall caps for H-1 wall types.
 - Added Granite Countertop GR-1 on Materials List per RFI A-08.

11. FPD2.01 FIRST FLOOR DEMOLITION – FIRE PROTECTION
 - Removed demolition of existing backflow preventer.
12. FP2.01 FIRST FLOOR CEILING PLAN – FIRE PROTECTION
 - Removed installation of new backflow preventer.
13. FP5.01 SCHEDULES – FIRE PROTECTION
 - Removed backflow preventer schedule.
14. FP6.01 DETAILS – FIRE PROTECTION
 - Removed horizontal double-check detector backflow preventer detail.
15. P5.01 SCHEDULES - PLUMBING
 - Added mixing valve model to L1 in Plumbing Fixture & Equipment Schedule.
16. M1.01 FIRST FLOOR PLAN - MECHANICAL
 - Indicated return grille airflows.
17. E0.01 COVER SHEET – ELECTRICAL
 - Added pressure switch to symbol list.
18. E1.01 FIRST FLOOR PLAN – ELECTRICAL
 - Revised storage room 120.1 to provide new tamper, flow, and pressure switches for the existing to remain backflow preventer.

PART 1 - GENERAL

1.01 GENERAL

- A. Work of this section shall be governed by the Contract Documents. Provide materials, labor, equipment and services necessary to furnish, deliver and install all work of this Section as shown on the drawings, as specified herein, and/or as required by job conditions.
- B. Drawings are diagrammatic and indicate a general arrangement of work. General design concepts indicated must be followed or bettered. The bid shall include offsets, additional piping, valves and plumbing equipment and components as required to meet construction conditions for proper operation. Do not scale drawings. Consult Architectural and Structural drawings for space conditions and additional fixtures. Develop and submit coordination drawings as outlined in Division 21 sections.
- C. The drawings and specifications are divided into sections to meet the needs of the architect, the engineers, and the design consultants. They are not prepared as instructions to the contractor for how to buy out or subcontract the work. The contractor is responsible for all the work described in the contract documents, regardless of where it is shown. For example, electrical work is shown on fp-series drawings as well as on m-series drawings and e-series drawings. Miscellaneous metals and structural elements are shown on a-series drawings as well as on s-series drawings. Structural supports are required by the fp drawings. To avoid omitting any component of the project, refer to all the contract documents in their entirety.
- D. Contractor to provide for additional shut-down and/or drainage of existing sprinkler system as required to accommodate owner's phasing/ step schedule.
- E. The work under this Section shall include all incidentals, labor, material, equipment, appliances, services, hoisting, scaffolding, supports, tools, consumable items, fees, licenses, and administrative tasks required to complete and make operable the plumbing work as intended.
- F. The Contractor shall furnish and install all equipment as necessary to provide a complete installation including coordination, system check out and start up on each item and system.
- G. This Contractor shall inform himself from the general construction specifications and plans, of the exact dimension of finished work and of the height of finished ceilings in all rooms where equipment or pipes are to be placed and arrange his work in accordance with the schedule of interior finishes, as indicated on the architectural drawings.
- H. Manufacturer's qualifications: firms regularly engaged in the manufacturer of fixtures, appliances, pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- I. Material qualifications: shall conform to all local, state, and national/federal codes and regulations which may apply and nothing in these specifications shall be interpreted as an infringement of such codes or regulations.
- J. Welding: qualify welding procedures, welders, and operators in accordance with ASME B31.1, or ASME B31.9, as applicable. Certify welding of piping work using Standard Procedure Specifications by, and welders tested under supervision of, National Certified Pipe Welding Bureau (NCPWB).
- K. Brazing: certify brazing procedures, brazers, and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, for shop and job-site brazing of piping work.
- L. The Contractor warrants that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and that the work will conform with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be

considered defective. Contractor shall warranty all work for a period of one year from Owner acceptance unless specified otherwise in which case longer equipment warranties may apply.

- M. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace the following components that fail in materials or workmanship within specified warranty period:
 - 1. Warranty Period, Commencing on Date of Substantial Completion: One (1) year.
 - 2. Comply with all current Federal, State, City and local codes, standards and ordinances, including referenced standards within the Building and Fire Codes.
- N. The contractor shall retain a professional engineer licensed in the state the project is being constructed in. NICET certification acceptable in accordance with State requirements. Submit stamped and signed drawings and calculations for fire protection work within the project scope of work.
- O. When a conflict between the drawings, notes and/or specifications occur, the more stringent, and/or larger quantity and/or more expensive shall apply. The requirements listed within notes or specifications shall be required, provided and installed whether specifically indicated on the drawings or not.
- P. The entire fire protection system(s) (wet, dry, preaction, gaseous, standpipe, as applicable) shall be considered a delegated design and the fire protection contractor shall be responsible for: permits, producing all shop drawings, calculations, submittals and installation of such equipment to ensure a complete and operational, code compliant system(s). The contractor is responsible for coordinating routing of fire protection systems with other trades including but not limited to, architectural, structural, mechanical, electrical, etc.

1.02 GUARANTEES AND SERVICES

- A. All workmanship, installation materials and equipment shall be maintained and serviced for the guarantee period at no additional cost to the Owner.
- B. Leave entire system installed under this Contract in perfect working order, and, without additional charge, replace any work or material which develops defects within the guarantee period, including all other work damaged as a result of such defects.
- C. Manufacturers' Warranties
 - 1. The manufacturer shall warrant that the equipment which he has furnished is free from defects in material and workmanship. Obligations under this warranty shall be as follows:
 - a. The equipment manufacturer or supplier shall provide and pay for all labor, parts, accessories, materials, freight and other services to repair or replace any equipment or part thereof which, in the course of installation, start-up and testing is found to be defective.
 - b. For a period of **twelve months** from the date of acceptance by the Owner, the manufacturer shall replace any defective equipment or part thereof; freight costs for return of defective parts, labor for parts replacement, are the responsibility of the installing contractor.
 - c. The manufacturer shall provide an additional warranty on all equipment as indicated in their respective specification section.
 - d. Performance - where equipment is specified by size, guarantee that it will have the capacity specified in the system in which it is installed.
 - 2. The final acceptance of the equipment will be made after the manufacturer has adjusted his equipment, balanced the various systems, demonstrated that it fulfills the

requirements of the drawings and specifications, and has furnished all the required certificates of inspection and acceptance.

1.03 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 019113 – General Commissioning Requirements
- C. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the CT High Performance Building Standard (CTHPS) Mandatory Requirements and minimum required sustainable strategies, as indicated on the Sustainable Matrix. Refer to Section 018113 - SUSTAINABLE DESIGN REQUIREMENTS for mandatory and targeted strategies.

1.04 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Mechanical sleeve seals.
 - 3. Sleeves.
 - 4. Escutcheons.
 - 5. Grout.
 - 6. Fire-suppression equipment and piping demolition.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. Painting and finishing.
 - 9. Concrete bases.
 - 10. Supports and anchorages.

1.05 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. 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 above ceilings and in chases.
- 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.

1.06 SUBMITTALS

- A. Procedure: Prepare and make the submissions listed below and in Division 1.
- B. Shop Drawings: Submit shop drawings of all items proposed to be furnished and installed under this Division.

- C. Manufacturer's Drawings.
 - 1. Equipment listed in each section, include material specifications, operating characteristics and finishes.
- D. Installation Drawings.
 - 1. Coordinated scale drawings of equipment including interconnecting piping and equipment.
 - 2. Coordinate space requirements for equipment and services.
 - 3. Include connections, anchorages and fastenings.
 - 4. Make allowance for clearances for access to and maintenance of equipment.
- E. Wiring and Control Diagrams.
 - 1. Electric wiring diagrams and automatic control diagrams and sequences of operation. The wiring diagrams must be complete and coordinated with the equipment actually installed.
- F. Provide composite shop drawings showing work of all related construction, when required to ensure full coordination and proper fitting of the work, and when directed by the Architect.
- G. Provide drawings showing dimensions and locations of concrete work required.
- H. Samples.
 - 1. Color samples for prefinished items.
- I. Reports / Contractor shall perform:
 - 1. Manufacturer's certified pressure tests on vessels.
 - 2. Manufacturer's certified performance tests on operating equipment.
 - 3. Field pipe testing reports and certificates of approval including:
 - a. Main drain test
 - a. Hydrostatic Tests, in accordance with NFPA 13, (200 psi and shall maintain that pressure without loss for 2 hours). Including existing systems prior to any work commencing, document test and any leaks.
 - b. Inspector's / flow test
 - c. Backflow full flow test
 - d. FDC piping has been tested
 - e. Air pressure leakage test (For dry / preaction systems) 40 psi for 24 hours <1 ½ psi of leakage, in accordance with NFPA
 - f. Dry pipe trip test (when applicable).
 - g. High/low air pressure test (when applicable).
 - h. Tamper switches have been tested
 - i. Underground piping test (when applicable), in accordance with NFPA 13.
 - 4. Welder's certificates and field test report.
 - 5. Field operating test results for operating equipment.
 - 6. Performance report on balancing of systems.
 - 7. Performance report and calculations for vibration isolation equipment.
 - 8. Manufacturer's certified reports on motorized equipment alignment and installation.

J. Statement of Compliance

1. Contractor shall submit a letter attesting the fire protection systems have been installed in accordance with the approved plans, manufacturer's equipment requirements and NFPA, any deviations must be clearly indicated.

K. If submissions of catalog cuts of standard manufactured items show different types, options, finishes, performance requirements, or other variations, those features proposed shall be clearly identified.

1. If any variations from the catalog description are proposed or required, such variations must be clearly noted on the cut.
2. Shop drawings shall clearly indicate all details, sectional views, arrangements, working and erection dimensions, kinds and quality of materials and their finishes, and other information necessary for proper checking and for fabrication and installation of the items, and shall include all information required for making connections to other work.
3. Shop drawings shall be numbered consecutively, and drawings related to various units comprising a proposed assembly shall be submitted simultaneously so that units may be checked individually and as an assembly.
4. Keep on the site, in good order, a complete up-to-date set of approved shop drawings. All shop drawings shall be available for inspection by the Architect.
5. On product data submittals, clearly indicate model numbers, dimensions, weights, electrical requirements, accessories and performance data. Submittals not properly prepared will be rejected without further review.
6. The review of shop drawings will be general, and shall not be construed as permitting any departure from the contract requirements other than those specifically brought to the Architect's attention and so approved.
 - a. If the shop drawings show any variations from contract requirements because of standard shop practices or other reasons, such variations shall be clearly identified on the drawings in order that, if acceptable, suitable action may be taken for proper adjustment in other work affected thereby.
 - b. Failure to identify such variations will not relieve the Contractor of responsibility for executing the work in accordance with the Contract even though such shop drawings have been reviewed and the work installed.
 - c. Review shall not relieve the Contractor of responsibility for any error in details, dimensions, etc., that may exist on shop drawings nor for the furnishing of materials or work required by the Contract and not indicated on the shop drawings.
 - d. Review shall not be construed as acceptable departure from details or instructions previously furnished by the Architect.
 - e. Review with a requirement for resubmission is a review contingent upon satisfactory resubmission within 30 days. Failure to comply shall result in a revocation of the contingent review.

L. Shop Drawing Schedule

1. The Contractor shall submit, within 30 days of the award of his contract, a schedule of all proposed shop drawing submissions.
2. The schedule shall include the following information.
 - a. Item to be submitted
 - b. Date of submission
 - c. Latest date for review
 - d. Manufacturers of the specified item.

3. Items not specifically listed as "approved equal" should be listed for consideration at this time.
 4. Shop drawings require a minimum of 10 business days from the date they have been received by the Consulting Engineer's office to adequately review the submittal. If there is any submittal which requires to be expedited sooner than the 10 business days, the Engineer shall be informed in writing at the beginning of construction with a list of those submittals.
- M. Submittals will be reviewed for conformance with the contract drawings and specifications. The engineer's review stamp will be affixed to submittals. One of the following actions will be taken:
1. Reviewed:
 - a. No comments, corrections, or marks have been made to the submittal. Re-review by the engineer is not required. The submittal is in general conformance with the design concept. Construction, fabrication and/or manufacture can proceed subject to the provision that the work shall be in accordance with the requirements of the Contract Documents. Final acceptance of the work shall be contingent upon such compliance.
 2. Furnish As Corrected
 - a. Comments, corrections, or marks made. Re-review is not required. Submission is in general conformance with the design concept subject to notations on the returned Submittal. Construction, fabrication, and/or manufacturer can proceed subject to the provisions that the work shall be carried out in compliance with all annotations and/or corrections indicated on the returned Submittal and in accordance with the Contract Documents. Final acceptance of the work shall be contingent on such compliance.
 3. Revise and Resubmit
 - a. Significant issues/discrepancies/incomplete information was provided in the Submittal. Revise or prepare a new submittal in accordance with the notations and Contract Documents. Resubmit without delay.
 4. Rejected
 - a. Submittal does not meet Contract document intent. Revise or prepare a new submittal in accordance with the notations and Contract Documents. Resubmit without delay.
- N. A submittal review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the shop drawings during this review do not relieve the contractor from Compliance with the requirements of the plans and specifications. Approval of a specific item shall not include approval of an assembly of which the item is a component. The contractor is responsible for: dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination of his or her work with that of all other trades; and for performing all work in a safe and satisfactory manner.

1.07 COORDINATION DRAWINGS

- A. Develop and submit coordination drawings as outlined.

- B. Sheet metal, plumbing and fire protection shop drawings that have been coordinated with architectural and structural drawings shall be submitted to engineer for review. Drawings must be returned from engineer either "reviewed" or "furnish as corrected" prior to being used as basis for coordination drawings.
- C. After sheet metal and piping drawings have been revised per engineers comments, reproducible copies shall be sent to the others trades in the following sequence for the inclusion of their work:
 - 1. Mechanical sheet metal
 - 2. Plumbing contractor
 - 3. Electrical work
 - 4. Mechanical piping
 - 5. Sprinkler piping
- D. After all trades have included their work on the coordination drawing and noted conflicts, all trades shall meet to resolve conflicts and agree to acceptable solutions. Each trade shall sign coordination drawings. Items not shown on coordination drawing is responsibility of omitting contractor and contractor is subject to additional costs incurred by other trades.
- E. The architect and engineer are not part of the coordination drawing process. The engineer will provide assistance for noted conflicts only. Coordination drawings are not to be considered piping or duct shop drawings. The contractor is required to submit individual piping and ductwork shop drawings for review by the engineer. Piping and ductwork shop drawings shall follow the design intent of the contract documents.
- F. Submit final signed coordination drawing to engineer for review. Engineer will review coordination drawings for general arrangement and for noted conflicts only. Specific installation requirements will be reviewed only in individual trade shop drawings.
- G. Any work fabricated or installed prior to sign off by all trades which is deemed to be in conflict with coordination drawings shall be removed and re-installed in conformance with coordination drawings.
- H. Each contractor (mentioned above) is responsible for the coordination of his sub-contractors.
- I. The overall coordination of the coordination process is the responsibility of the contractor. The engineer is not responsible for the coordination process. The engineer will respond to questions that arise from the coordination process. Drawings submitted will be reviewed for clearly identified conflicts only. Solutions to conflicts will not bear additional cost.

1.08 RECORD DRAWINGS

- A. Provide a complete set of as-built drawings reflecting as installed conditions. As-built drawings shall indicate all installed conditions of systems within this discipline. Drawings shall be of similar scale as the construction documents and include details as necessary to clearly reflect the installed condition. Drawings shall be bound in a complete and consecutive set. Supplemental sketches and loose paperwork will not be acceptable and will be returned for revision. The contractor shall comply with the engineer's comments to produce a clear and concise set of drawings. Drawings shall be submitted in both hard copy and electronic (Auto-cad or Revit version as required by the owner) version. Number of copies of each as requested by the owner.
- B. Provide "as-built drawings" indicating in a neat and accurate manner a complete record of all revisions of the original design of the work. Indicate the following installed conditions:
 - 1. Include all changes and an accurate record, on reproductions of the contract drawings or appropriate shop drawings, of all deviations, between the work shown and work installed.

2. Mains and branches of piping systems, with valves and control devices located and numbered, Valve location diagrams, complete with valve tag chart.
 3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 4. Approved substitutions, contract modifications, and actual equipment and materials installed.
 5. Contract modifications, actual equipment and materials installed.
- C. Submit for review bound sets of the required drawings, manuals and operating instructions.
- D. Submit a complete maintenance manual of all equipment installed under this contract.

1.09 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. All fire protection equipment / materials shall be sheltered from the weather, covered, and kept off the ground to prevent rust and debris from entering. Materials shall be kept in a safe / secure location from other equipment and/or construction processes to prevent damage or theft.
- C. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.11 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.12 CLEANING

- A. Contractor shall maintain areas control free of waste materials, debris, and rubbish. Maintain in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces before closing the space / finishing work in that area.

- C. Contractor shall periodically clean interior areas before end of each working day and continue cleaning on an as-needed basis.
- D. Contractor shall ensure that dust and other particulates from their work does not travel into areas not being renovated.
- E. Contractor shall remove waste materials, debris, and rubbish from site daily and dispose of legally off-site. No scrap/debris shall remain inside the building or anywhere on site upon final acceptance of the project.
- F. Final cleaning: at completion of work, remove all remaining waste materials, rubbish, tools, equipment, machinery and surplus materials, and clean all exposed surfaces; leave project clean and ready for occupancy.

1.13 TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire equipment including: fire pumps, riser check valve assemblies, dry pipe valve assemblies, preaction valve assemblies, fire standpipe valves, pressure regulating valves, flow switches, tamper switches, etc.

PART 2 - PRODUCTS

2.01 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.
- B. Obtain all general conformances in accordance with Division 1 - General Requirements.
- C. Submit to the Architect for review a list of manufacturers of equipment proposed for the work. Intent to use exact make specified does not relieve the Contractor of responsibility for submitting the required list.
- D. Where any specific materials, process or method of construction, or manufactured article is specified by name or by reference to catalog number of a manufacturer, or other standards, the intent is not to take precedence over the basic duty and performance specified, noted on drawings, or as required for intended results. In all cases, verify the duty specified with the specific characteristics of the equipment offered for review.
- E. Equipment of one type, shall be products of one manufacturer, a manufacturers actual cut sheet and not from a distributor.

2.02 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.

- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.04 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.05 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.06 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.07 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.08 PIPE PAINTING

- A. Paint all interior piping with two coats of enamel epoxy type paint. Prep, clean and prime pipe surfaces, in accordance with paint manufacturers specifications / recommendations prior to installation and final color application.
- B. Contractor shall ensure paint and primer are compatible with one another and material being painted.
- C. Paint color shall match existing wall color, coordinate with the Owner's requirements prior to installation.
- D. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
- F. Piping and fittings exposed to corrosive and/or high humidity areas (i.e. greater than 50% rh) shall be galvanized schedule 40 steel with epoxy coating similar to Ameron. Sprinkler heads within these areas shall also be corrosive / moisture resistant (i.e. Teflon coated). Pipe hangers and components within these areas shall be hot dipped galvanized steel with epoxy coating. Similar to Ameron.

PART 3 - EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
 - g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.
 - i. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - j. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
 - k. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Provide listed fire stopping material (coordinated with wall, ceiling etc rating) for all penetrations.

- O. Permanent sleeves are not required for holes formed by removable PE sleeves.
- P. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- Q. 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.
 - a. Exception: Extend sleeves installed in floors of mechanical 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.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are 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 NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 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. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- R. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- T. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

- U. Verify final equipment locations for roughing-in.
- V. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.03 PAINTING

- A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.04 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 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 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.05 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.06 GROUTING

- A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.07 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.
- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.
- C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the startup procedure.
- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENT

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 019113 – General Commissioning Requirements

1.02 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Cover system for sprinkler piping.
 - 3. Specialty valves.
 - 4. Sprinklers.
 - 5. Alarm devices.
 - 6. Manual control stations.
 - 7. Control panels.
 - 8. Pressure gages.

1.03 DEFINITIONS

- A. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig, but not higher than 250 psig.
- B. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. HYDRAULIC SUMMARY DATA SHALL BE INCLUDED ON SHOP DRAWINGS.
 - 2. Contractor shall document (in schematic way) in which area is supplied including pipe sizes, overall length of piping, etc. as necessary to perform hydraulic calculations.
 - 3. Calculations shall include a 10 psi "Cushion" between required flow/pressure and available flow/pressure.
 - 4. Hydraulic reference points shall be clearly indicated on drawings. Do not use "pipe numbers", provide consecutively numbered reference points at all areas indicated on hydraulic calculations including at connection to street main.
 - 5. Hydraulic calculations shall include a minimum of 1500 sq.ft. for all remote areas. Grid calculations shall include "Peaking" process (per NFPA requirements) to ensure calculation of most remote area.
 - 6. For areas having unsprinklered combustible concealed spaces (as described in NFPA 13,) the minimum area of sprinkler protection shall be 3,000 sq.ft.
 - 7. Increase hydraulic remote area for all dry and double interlocked preaction systems.
 - 8. Increase hydraulic remote area by 30% for sprinklers used on sloped ceilings with a pitch exceeding one in six (16.7%).

9. Use of: line spacing off wall in excess of 7'-6", remote area reductions, etc. (as noted in NFPA 13) are not permitted.
10. Contractor shall submit hydraulic calculations for all sprinkler and standpipe systems, including all hazard areas; (i.e. wet, dry, preaction, light, ordinary, extra, etc.) to Insurance carrier, engineer, architect and Fire Marshal.
11. Residential areas shall be calculated in accordance with NFPA 13
12. Exposure sprinkler demand shall be calculated in accordance with NFPA 13, and added to the required wet system demand.
13. Include plans, elevations, sections, and attachment details.
14. Include diagrams for power, signal, and control wiring.
15. Provide dimensional installation piping layout/s coordinated with all trades. Include all sprinkler piping, drains, pipe sizes, hanger styles and locations, valves, alarm equipment, and all other items for a complete shop drawing. Submittal shop drawings shall be clear and legible. All sprinkler information must stand out on the shop drawings (ie: bold piping, etc. or lighter background).
16. Include a complete riser diagram indicating new and existing fire protection equipment, hydraulic reference points and elevations at each floor.
17. Provide a full height building cross section noting elevations, types of construction, and locations of ceilings, walls/partitions, and piping.
18. Include a site plan indicating flow test location, north arrow, underground supply piping, building location and adjacent streets.
19. Contractor to indicate number of sprinkler heads and types per floor.
20. Contractor to dimension distance from: sprinkler head to sprinkler head, sprinkler head to wall, etc.
21. Determine deviations from specifications and drawings and indicate on shop drawings.
22. Provide definition/description of sprinkler identification for all sprinklers.
23. Submit all fire protection drawings and calculations to the local AHJ - "Authority having jurisdiction" (ie: Fire Marshal), owners insurance company, architect and engineer. Secure approval prior to installation.
24. The contractor shall retain a professional engineer licensed in the state the project is being constructed in. NICET certification acceptable in accordance with State requirements. Submit stamped and signed drawings and calculations for fire protection work within the project scope of work.
25. Shop drawings and hydraulic calculations shall be submitted, architect and engineer. Submitted drawings and calculations shall be stamped by a professional engineer licensed in the State of Connecticut. Secure approval prior to installation.

1.05 CRITERIA

- A. Sprinkler system design shall be approved by authorities having jurisdiction.
- B. Margin of Safety for Available Water Flow and Pressure: **10 psi**, including losses through water-service piping, valves, and backflow preventers.
- C. Sprinkler Occupancy Hazard Classifications shall be in accordance with NFPA 13, local AHJ and owner's insurance company requirements.
- D. Minimum Density for Automatic-Sprinkler Piping Design shall be in accordance with NFPA 13, local AHJ and owner's insurance company requirements.
 1. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area plus 100 gpm outside hose..
 2. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area plus 250 gpm outside hose.
 3. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area plus 250 gpm outside hose.

4. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area plus 500 gpm outside hose.
5. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area plus 500 gpm outside hose.
6. Special Occupancy Hazard: As determined by authorities having jurisdiction.

1.06 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Domestic water piping.
 2. Compressed air piping.
 3. HVAC hydronic piping.
 4. Items penetrating finished ceiling include the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
- B. Qualification Data: For qualified Installer and professional engineer.
- C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Contractor responsible to document and submit "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- E. Samples
 1. Submit samples on the following items:
 2. Sprinkler heads, escutcheons, head guards, valve tags and pipe markers.
- F. Operating instructions and parts lists.
 1. Before requesting acceptance of work, furnish five (5) printed and bound sets.
 2. Equipment and systems: Brief description of equipment and systems and basic operating features. Manufacturer's name, (include address and telephone number) model number, service manual, spare parts lists, wiring diagrams and descriptive literature for all components.
 3. Maintenance instructions.
 4. Instructions for starting and operation.
 5. Detailed and simplified type, one line color coded flow and wiring diagrams.
 6. Witnessed CONTRACTOR'S MATERIAL AND TEST CERTIFICATE FOR ABOVE GROUND and UNDERGROUND PIPING (FIELD TEST REPORTS). Provide on owner's insurance carrier forms as required.
- G. Welding certificates.
- H. Fire-hydrant flow test report.
 1. Provide less than (1) year old 3-way water flow data including:
 - a. Date and Time of test, including water company
 - b. Static & residual pressures
 - c. GPM

- d. Size of water main
 - 2. Fire Protection section of specifications shall include hydrant "three point" flow test data. Ref. also to "Fire Protection and Water Supply" Section 2.4.7 of the Consultant's Procedure Manual.
 - 3. The water test shall conform to the procedures described in the National Fire Protection Association (NFPA) Standard 291, "Fire Flow Testing and Marking of Hydrants", (specific edition currently enforced by codes); or the procedures described in the NFPA Handbook "Testing of Water Supplies". The results of the water flow test shall be plotted in the form of a three-point curve to ensure accuracy of the test results. The water flow test report is to be included in the "Sprinkler" section of the specifications.
 - I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
 - J. Field quality-control reports.
- 1.07 CLOSEOUT SUBMITTALS**
- A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.
- 1.08 AS-BUILT / RECORD DRAWINGS**
- A. Provide a complete set of as-built drawings reflecting as installed conditions. As-built drawings shall indicate all installed conditions of systems within this discipline, include hydraulic calculations. Drawings shall be of similar scale as the construction documents and include details as necessary to clearly reflect the installed condition. Drawings shall be bound in a complete and consecutive set. Supplemental sketches and loose paperwork will not be acceptable and will be returned for revision. The contractor shall comply with the engineer's comments to produce a clear and concise set of drawings. Drawings shall be submitted in both hard copy and electronic (Auto-cad or Revit version as required by the owner) version. Number of copies of each as requested by the owner.
 - B. Provide "as-built drawings" indicating in a neat and accurate manner a complete record of all revisions of the original design of the work.
 - C. Drawings shall be submitted in both hard copy and electronic (AutoCAD and Revit version as required by the Owner). Number of copies of each as requested by the Owner, minimum of four copies
 - 1. Indicate the following installed conditions:
 - a. Include all changes and an accurate record, on reproductions of the contract drawings or appropriate shop drawings, of all deviations, between the work shown and work installed.
 - b. Mains and branches of piping systems, with valves and control devices located and numbered, and with items requiring maintenance located. Valve location diagrams, complete with valve tag chart.
 - c. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - d. Approved substitutions, contract modifications, and actual equipment and materials installed.
 - e. Contract modifications, actual equipment and materials installed.

- f. Submit for review bound sets of the required drawings, manuals and operating instructions.
 - g. Submit a complete maintenance manual of all equipment installed under this contract.
- D. Contractor shall provide laminated riser diagram indicating all valves, (including pressure reducing type) their locations and various sprinkler/standpipe zones. Riser diagram shall be permanently mounted within the fire pump / fire service room.
- E. Contractor shall place As-built drawings (hard copy and USB), valve schedule etc. within surface mounted Plans Box Labeled "Fire Protection Drawings" Similar to DSB ACE-12 drawing storage box, 37"x5 1/2" x 4 1/4" .

1.09 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. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.10 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Furnish manufacturers operating and maintenance instructions, parts lists and sources of supply for replacements in accordance with Division 1 - General Requirements.
- B. Provide the following:
 - 1. Information shall include: drawings, hydraulic calculations, above and below ground pipe testing, waterflow test, equipment "cut" sheets along with a copy of NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems (adopted edition State recognizes) bound in a folder.
- C. Master Operating Manual (submit in quadruplicate)
 - 1. Complete sets of final and correct shop drawings, maintenance and replacement parts manuals, and operating instructions, for equipment supplied.
 - 2. Bind each set within a common binder. Index and organize with a table of contents, to permit quick and convenient reference.
 - 3. Three days of instruction in operation and maintenance of equipment to Owner's maintenance force. Design a 2-week period, convenient to Owner, during which qualified personnel, including manufacturers' technicians and engineers will be available for Owner's instruction.
 - 4. Manufacturer's mechanical and electrical equipment parts lists of all components of the systems listed on the equipment schedules, control diagrams and wiring diagrams of controllers.
 - a. List shall give system number, unit number, manufacturer's model number, and manufacturer's drawing numbers.
 - 5. Step by step operating instructions for each system including preparation for starting, shutdown and draining.
 - 6. Maintenance instructions for each type of equipment.
 - 7. List of nearest local suppliers for all equipment.

8. Manufacturer's literature describing each piece of equipment listed on the equipment schedules, control diagrams and wiring diagrams as applicable.
9. Description of sequence operation by the control manufacturer, as applicable.
10. Recommended trouble shooting procedures in the event of foreseeable mechanical system failure.
11. List of various sprinkler and/or standpipe zones including graphic diagram.
12. Chart of the tag numbers, location and function of each valve.
13. Copies of the following test reports:
 - a. Aboveground and underground piping.
 - b. Current, less than 1 year old water flow test.

1.11 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.
- C. Quality of Materials.
 1. All equipment and materials shall be UL listed and Factory Mutual approved.
 2. New, best of their respective kinds and free of defects.
 3. Electrical equipment: Listed by Underwriters Laboratories or bearing their label. Secure approval from Architect, Engineer and all authorities having jurisdiction for materials, equipment and installation prior to installation.
 4. All fire protection Work shall be free from defects in workmanship and materials for a period of one (1) year from date of final acceptance shall meet all local and state codes. All defects, which develop or are discovered within this period, shall be repaired by the Contractor to the satisfaction of the Owner and at no additional cost.

1.12 WORKMANSHIP

- A. Perform all work in a practical, neat and workmanlike manner with mechanics skilled in work, and using the best practices of the trade involved.
- B. No work shall be concealed until it has been inspected and approved by the Architect.
- C. Workmanship or materials not meeting with requirements of the specifications and drawings and satisfaction of the Architect shall be rejected and immediately replaced in an acceptable manner, without additional cost to the Owner.
- D. Where any portion of a system is subject to freezing and the temperatures cannot be reliably maintained at or above 40°F (4°C), the system shall be installed as a dry pipe or preaction system

1.13 CONTRACT DOCUMENTS

- A. The Contract Documents are diagrammatic and are intended to convey the scope of work and indicate general arrangements of piping, sprinkler heads, etc. Any work or materials in addition

to or different from these Contract Documents as required to provide a complete system shall be furnished and installed at no additional cost. During the bid period the Contractor shall examine the site and construction documents of the proposed work to determine the existing conditions that may affect their work. The contractor shall identify and submit any problematic conditions in writing to the Architect prior to submitting the bid.

B. Sprinkler Permits and Water Service

1. Arrange with local authorities for all permits and approvals, provide all necessary documentation.
2. Pay required charges.
3. Coordinate any fire protection shut-downs with the building Owner and the building's Insurance company. Minimize the fire protection "down time" and place the system back into service at the end of each working day. Coordinate any situation which may require over-night fire watch with the construction manager and building owner.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
1. NFPA 13.
- B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- C. High-Pressure Piping System Component: Listed for 250-psig minimum working pressure.
- D. All components must be approved by Factory Mutual and comply with FM data sheets.
- E. All components must be UL and/or FM approved. FM approval is mandatory for projects insured by FM Global and/or local AHJ

2.02 STEEL PIPE AND FITTINGS

- A. Schedule 10, black steel Pipe: ASTM A 135, Type E, Grade A (1 ½" – 8" NPS), UL/FM listed.
- B. Schedule 40, black steel Pipe: ASTM A 53, Type E, Grade A (1"-1-1/4" NPS), UL/FM listed.
- C. Schedule 40, Galvanized-Steel Pipe (drain, dry, exterior piping, etc.): ASTM A 795, / A53 Type E, Grade A/B, hot dipped galvanized NPS 8" and smaller. UL/FM listed.
1. Products: Sprinkler piping subject to compliance with requirements, provide one of the following:
 - a. Wheatland tube.
 - b. Bullmoose Tube.
 - c. State Pipe & Supply, Inc.
 - d. Youngstown Tube.
 2. Provide brass type elbows on exterior drains exiting the building, coordinate with architect.
- D. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, ERW steel pipe with threaded ends.

- E. Galvanized-Steel Couplings: ASTM A 865/A 865M, threaded.
- F. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- G. Malleable- or Ductile-Iron Unions: UL 860.
- H. Cast-Iron Flanges: ASME 16.1, Class 125.
- I. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
 - 1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or EPDM rubber gasket.
 - a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
 - b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
 - 2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.
- J. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
 - 1. 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.
- K. Threaded fittings:
 - 1. Malleable Iron or Ductile Iron. Cast Iron not acceptable.
- L. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anvil International.
 - b. Smith-Cooper International.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - 2. Pressure Rating: 300-psig minimum.
 - 3. Galvanized Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
- M. Installation- ready fittings / grooved fittings shall not be utilized within exposed / architecturally sensitive areas without approval from architect.
- N. Utilize number of flexible type couplings as required for piping to follow curvature of ceiling / catenary structural members. Coordinate with manufacturer specifications, Similar to Grinnell figure 705 Flexible Coupling.
- O. Utilize flexhead fire pipe to provide for normally anticipated roof deflection. Coordinate with manufacturers requirements. Contractor to incorporate friction loss into hydraulic calculations. Similar to Anvil / Victaulic brand, UL/FM listed.
- P. Install flexible connections in piping where they cross seismic joints or building expansion joints. Flexible connection shall be similar to Metraflex Metrafire Loop and coordinated with requirements of NFPA 13, 9.3.2.3 regardless of building's seismic zone.

2.03 PIPE PAINTING

- A. Paint all exposed interior piping with two coats of enamel epoxy type paint. Prep, clean and prime pipe surfaces, in accordance with paint manufacturers specifications / recommendations prior to installation and final color application.
- B. Contractor shall ensure paint and primer are compatible with one another and material being painted.
- C. Paint color shall match existing wall color, coordinate with the Owner's requirements prior to installation.
- D. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
- F. Piping and fittings exposed to corrosive and/or high humidity areas; exterior, attics, basements (i.e. greater than 50% rh) shall be galvanized schedule 40 steel (nitrogen systems shall be schedule 40 steel) with epoxy coating similar to Ameron. Sprinkler heads within these areas shall also be corrosive / moisture resistant (i.e. Teflon coated). Pipe hangers and components within these areas shall be hot dipped galvanized steel with epoxy coating similar to Ameron.
- G. Paint and primer shall meet LEED requirements for V4.1 Credit including : 75% (by vol or SA) of adhesive/sealants and/or paints/coating. Any mastics/adhesives, sealants, coatings, or insulation specified for use on the interior of the building will need to meet the VOC-content requirements AND the emissions requirements (for wet-applied products).

2.04 SPECIALTY VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating:
 - 1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.
 - 2. High-Pressure Piping Specialty Valves: 300-psig.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.

~~F. Double Check Backflow Preventers:~~

- ~~1. Basis of Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - ~~a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.~~
 - ~~b. Conbraco Industries, Inc.; Apollo Valves.~~
 - ~~c. FEBCO; SPX Valves & Controls.~~
 - ~~d. Watts Water Technologies, Inc.~~
 - ~~e. Zurn Plumbing Products Group; Wilkins Water Control Products Division.~~~~
- ~~2. Standards: ASSE 1048 and UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.~~
- ~~3. Operation: Continuous pressure applications.~~

- ~~4. Size: As determined through hydraulic calculations~~
- ~~5. Design Flow Rate: as required through hydraulic calculations.~~
- ~~6. Body Material: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.~~
- ~~7. Standards: UL 312 and FM Global's "Approval Guide."~~
- ~~8. Pressure Rating: 175 psig.~~
- ~~9. End Connections: Flanged.~~
- ~~10. Provide metered by pass~~
- ~~11. Configuration: Designed for horizontal, straight through flow.~~
- ~~12. Accessories:~~
 - ~~a. Valves: UL 262, "Approval Guide," published by FM Global, listing, approved; OS&Y gate type with flanged ends on inlet and outlet.~~
- ~~13. Backflow preventers shall have piping, fittings, normally closed valve, etc. as required to perform the full flow test in accordance with NFPA 13.~~
- ~~14. Contractor shall coordinate with water authority and existing space requirements.~~

G. Automatic (Ball Drip) Drain Valves:

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc. (The).
 - b. Tyco Fire & Building Products LP.
- 2. Standard: UL 1726.
- 3. Pressure Rating: 175-psig minimum.
- 4. Type: Automatic draining, ball check.
- 5. Size: NPS 3/4.
- 6. End Connections: Threaded.

H. Air Venting Valves:

- 1. Shall be located near a high point in the system to allow air to be removed from that portion of the system. Provide one air vent for each sprinkler control assembly.
- 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Potter
- 3. UL / FM Approved
- 4. Furnish and install a ball valve prior to the "Y" type strainer to isolate the automatic air release valve and strainer from the system for replacement of the automatic air vent or WAGS or strainer maintenance.
- 5. Ball valve shall be supervised.
- 6. Output 1/2" NPT
- 7. Provide strainer connected to air vent
- 8. Mount in a vertical, accessible location with 8" of clearance above the sprinkler main.
- 9. The output of the air vent valve shall be piped to a secondary automatic shut off valve, (WAGS). All components shall be brass.
- 10. The WAGS shall be factory installed in a water retention pan. In the event the primary automatic air vent fails to close and water begins to discharge, the water will flow through the WAGS and into the water retention pan. When the water level in the retention pan reaches a pre-determined level, a water soluble element in the WAGS shall dissolve and release a powerful spring loaded piston to provide a positive water shutoff. Operation of

- the WAGS shall activate a switch capable of being monitored by a fire alarm panel or remote indicator.
11. Provide drain pan with piping routed to sanitary. Contractor shall indicate vent location and piping path from the vent to the termination point
 12. Similar to Potter Automatic air release PAAR-B
- I. Universal Manifold assembly:
1. Out of the box unit, contains: control valve with tamper switch, flow switch, pressure gauge, pressure relief valve, test and drain assembly (with check valve as required by NFPA).
 2. UL/FM listed
 3. Provide custom sized cabinet, rated to wall assembly, coordinate color and door type with Architect.
- J. Similar to:
1. Victaulic UM universal manifold assembly
 2. Reliable Model FCA Floor Control Assembly
 3. Globe, UMC Universal Manifold Check Assembly
- K. All drain / test valves shall have permanent signage indicating areas served and exact location where the drains are routed to (i.e. exterior and/or mop sink etc.) in order that personnel may monitor these locations during testing and/or draining of the system.

2.05 ACCESS DOORS

- A. All cabinet locations shall be coordinated with Architect prior to installation
- B. For rated surfaces:
1. 16 gauge steel frame, 20 gauge steel welded pan type door, 1" wide 16 gage steel door flange with continuous hinge.
 2. Door shall be filled with fire rated insulation and have automatic closer, be self latching and contain interior latch release.
 3. Latches shall be bolt type, operated by a ring turn.
 4. Finish shall be prime coat of rust inhibitive electrostatic powder baked grey enamel.
 5. Approved equal to KARP model KEP-150FR. Or approved equal.
- C. For non-rated surfaces:
1. 16 gauge steel frame, 14 gauge steel door, frame flange shall be one-piece construction, 3/4" wide. Hinge shall be concealed, continuous piano type.
 2. Lock shall be flush, screwdriver operated with stainless cam and studs.
 3. Masonry applications shall include masonry anchor straps.
 4. Base application shall be prime coat of rust inhibitive electrostatic powder baked grey enamel. Custom color finish to be determined by Architect.
 5. Approved equal to KARP model DSC-214M. Or approved equal.

2.06 VALVE CABINETS (as applicable).

- A. Sized for control valve to elevator sprinklers
- B. Size: 18" h x 18" w x 8" d.
- C. Construction: 20 gauge sheetmetal box, 20 gauge tubular steel door with 20 gauge door frame and a continuous steel hinge (brass pin). Steel corner seams welded and ground smooth. All

components powder-coated with an electrostatically-applied, thermally-fused, recoatable white polyester finish. With a locking door lever latch.

- D. Cabinet rating shall be similar to wall rating
- E. Labeling: "ELEVATOR SPRINKLER VALVE"
- F. Similar to:
 - 1. Fire rated cabinet: POTTER-ROEMER Model FRC-1810.
 - 2. Non-rated cabinet: POTTER-ROEMER Model 1810

2.07 SPRINKLER PIPING SPECIALTIES

- A. Branch Outlet Fittings:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anvil International.
 - b. Shurjoint Piping Products.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - 2. Standard: UL 213.
 - 3. Pressure Rating: 175-psig minimum.
 - 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 - 5. Type: Mechanical-tee and -cross fittings.
 - 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 - 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 - 8. Branch Outlets: Grooved, plain-end pipe, or threaded.
 - 9. Utilize solid back type mechanical fittings.
- B. Flow Detection and Test Assemblies:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc. (The).
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - 2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
 - 3. Pressure Rating: 175-psig minimum.
 - 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 - 5. Size: Same as connected piping.
 - 6. Inlet and Outlet: Threaded or grooved.
- C. Branch Line Testers:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Elkhart Brass Mfg. Co., Inc.
 - b. Fire-End & Croker Corporation.
 - c. Potter Roemer LLC.

2. Standard: UL 199.
3. Pressure Rating: 175 psig.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGF Manufacturing Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company; TestMaster™ II Alarm Test Module Style 720.
 - d. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Drain termination:

1. All drain piping and fittings shall be galvanized.
2. Provide necessary piping as required to route to the exterior of building
3. Drains shall not cause damage to landscaping, the building and/or discharge onto sidewalks.
4. Provide splash blocks
5. Utilize MIFAB Series solid hinged downspout cover, custom color. Architect to determine.

F. Flexible Sprinkler Hose Fittings:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fivalco Inc.
 - b. FlexHead Industries, Inc.
 - c. Gateway Tubing, Inc.
 - d. Victaulic Company; VicFlex™ Braided Sprinkler Fitting Assembly.
2. Standard: UL 1474. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
3. Pressure Rating: 175-psig minimum.
4. Size: Same as connected piping, for sprinkler.
5. Contractor shall confirm use of flex head type system does not cause excessive pressure losses which exceed the available water supply, otherwise utilize hard pipe method at no additional cost

2.08 SPRINKLERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. Reliable Automatic Sprinkler Co., Inc. (The).

2. Tyco Fire & Building Products LP.
 3. Victaulic Company; Victaulic Sprinkler Heads.
 4. Viking Corporation.
- B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- C. Pressure Rating for Residential Sprinklers: 175-psig maximum.
- D. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
- E. Pressure Rating for High-Pressure Automatic Sprinklers: 250-psig minimum.
- F. Automatic Sprinklers with Heat-Responsive Element:
1. Early-Suppression, Fast-Response Applications: UL 1767.
 2. Nonresidential Applications: UL 199.
 3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
 4. Temperature ratings must be in accordance with NFPA 13, owner's insurance carrier and AHJ's requirements. Contractor must coordinate with maximum ceiling temperatures (as outlined in NFPA 13). Provide intermediate and high temperature heads as required / applicable (i.e. skylights, attics, mechanical rooms, etc.).
- G. Sprinkler Finishes: Refer to schedule on drawings.
- H. Special Coatings: corrosion-resistant paint.
- I. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- J. Sprinkler Guards:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc. (The).
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
 2. Standard: UL 199.
 3. Type: Wire cage with fastening device for attaching to sprinkler.
 4. Provide on all exposed sprinklers subject to mechanical damage and/or <7'-6" AFF
- K. Water Shields: Provide listed water shields on all sprinklers below open grading.

2.09 PRESSURE GAGES

- A. Products: Subject to compliance with requirements, provide one of the following:
1. AGF Manufacturing Inc.
 2. AMETEK, Inc.
 3. Ashcroft Inc.
 4. Brecco Corporation.

- 5. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0 to 300 psig.
- E. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Where conflicts occur between drawings and specifications, or within either document, the Contractor shall ask for and obtain a written clarification from the Engineer prior to submitting his bid. Otherwise, the items or arrangements of superior quality, greater quantity or higher cost shall prevail and be included in the contract price.
- B. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- C. Report test results promptly and in writing.

3.02 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. All lower level sca's shall have a valved threaded capped outlet for draining system and a valved outlet with drain routed to exterior for testing system.
- J. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

- K. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- L. Install alarm devices in piping systems.
- M. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
- N. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.03 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

- I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.04 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. Install valves in vertical position for proper direction of flow, in main supply to system.
 - 2. Install alarm valves with bypass check valve and retarding chamber drain-line connection.
 - 3. Install deluge valves in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

3.05 SPRINKLER INSTALLATION

- A. Sprinkler head finishes shall be coordinated and approved by Architect prior to installation
- B. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- C. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- D. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid (when applicable)
- E. All piping and sprinklers shall be of the concealed type in areas where ceilings exist. Exposed piping and sprinklers shall be installed in areas without ceilings. All fire protection work shall be coordinated with other trades including the buildings architectural features (lights, diffusers, etc.).
- F. Do not run exposed piping in front of windows and skylights. Keep all piping as high as possible. Coordinate all piping with other trades. Concealed piping should be elevated +/- 6" above the ceiling. Coordinate all piping with lights and diffusers. The ceiling construction consists of a rated assembly and therefore all sprinkler piping shall meet the requirements of NFPA, to ensure continuous rating
- G. Clearance from electrical equipment
 - 1. In accordance with NFPA 70 and only allowed above the dedicated space or working space.

2. Piping (except for piping directly supplying sprinklers for such rooms):
 - a. Prohibited, except as noted, in:
 - 1) Electric Rooms and Closets.
 - 2) Telephone Equipment Rooms and Closets.
 - 3) Elevator Machine Rooms.
 - 4) Data Rooms, IDF/MDF Closets (attempt not to route piping directly above any/all data racks).
 - b. Limit couplings / fittings within these rooms
 - c. Prohibited, except as noted, over or within 5 feet of:
 - 1) Transformers.
 - 2) Substations.
 - 3) Switchboards.
 - 4) Motor control centers.
 - 5) Standby power plant.
 - 6) Bus ducts.
 - d. When over or within 5 feet unavoidable, provide custom painted drip pans under piping over electrical equipment.

3.06 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and as specified in Section 210553.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.07 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 4. Energize circuits to electrical equipment and devices.
 5. Coordinate with fire-alarm tests. Operate as required.
 6. Coordinate with fire-pump tests. Operate as required.
 7. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.08 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.09 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

3.10 PIPING SCHEDULE

- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.
- B. Refer to schedule on drawings.

3.11 SPRINKLER SCHEDULE

- A. Refer to schedule on drawings

END OF SECTION

PART 1 - GENERAL

1.01 LEAD-FREE STATEMENT

- A. Several plumbing fixtures described in this section fall under jurisdiction of the Federal Reduction of Lead in Drinking Water Act (42 USC 300G) which mandates that effective January 4, 2014 the wetted surfaces of any valve, fitting or fixture that comes in contact with potable water must have a weighted-average lead content of no more than 0.25 percent. The contractor shall be responsible for providing products that are Lead-Free products and meet the requirements of Safe Drinking Water Act Section 1417 (e) (Section 9 of NSF/ANSI Standard 61) and authorities having jurisdiction.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

- A. Section Includes:
 - 1. Balancing valves.
 - 2. Temperature-actuated, water mixing valves.
 - 3. Strainers.
 - 4. Drain valves.
 - 5. Water-hammer arresters.
 - 6. Flexible connectors.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
 - 1. Include diagrams for power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 and NSF 14.
- B. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.02 BALANCING VALVES

- A. Lead Free Copper-Alloy Calibrated Balancing Valves:
1. Products: **Subject** to compliance with requirements, provide one of the following:
 - a. Bell and Gossett; insert product designation.
 - b. Cimberio
 - c. Danfoss; insert product designation.
 - d. Watts; a Watts Water Technologies company.
 2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
 3. Body: Brass or bronze.
 4. Size: Same as connected piping, but not larger than NPS 2.
 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- B. The Thermostatic Zone Valve shall have a solid brass body with corrosion-resistant internal components. It shall include an integral check valve and strainer to prevent backflow and filter debris from entering the valve. Zone temperature adjustment shall be from 100°F to 160°F (38°C to 71°C) and is made using an Allen wrench and a locknut on the bonnet prevents unauthorized or accidental temperature adjustment. Valve shall proportionally modulate to maintain zone temperatures based on heat loss and shall stabilize pump demand to prevent cycling. The TZV modulates its Cv from a maximum of 0.7 to a minimum of 0.05 with a 10°F (5.6°C) change in zone temperature. The valve shall not have positive shut-off thereby preventing pump dead-heading and/or subsequent overheating.
1. Manufacturers:
 - a. Acorn model TZV.
 - b. JRGutherm 6320
 - c. Cimberio 778
 - d. Caleffi 116
 - e. Viega (1" size only)

2.03 TEMPERATURE-ACTUATED, WATER MIXING VALVES

- A. Lead free, Lavatory, Tempering Valve:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Acorn Controls
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. Powers; a division of Watts Water Technologies, Inc.
 - e. Symmons Industries, Inc.
 - f. PPP Inc.
 2. Description: IAPMO lab certified per ASSE 1070 at 0.25 gpm (1.0 lpm) and CSA standards and shall have a solid brass body with corrosion resistant internal components. It shall include integral checks with screens to prevent backflow and to filter debris from entering the valve.
 3. Pressure Rating: 125 psig maximum unless otherwise indicated.
 4. Flow: Valve shall provide 4.0 gpm with 3/8" compression connection and 4.5 gpm capacity with the 1/2" NPT connection at 45 psi differential.

5. Tempered-Water Setting: 85-115° F
6. Thermostatic Mixing Valve and Water Regulator Finish: Rough bronze.

2.04 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: per manufacturers recommendation.
 - b. Strainers NPS 2-1/2 to NPS 4: per manufacturers recommendation.
 - c. Strainers NPS 5 and Larger: per manufacturers recommendation.
6. Drain: Pipe plug or Factory-installed, hose-end drain valve.

2.05 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.06 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Precision Plumbing Products, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Watts Drainage Products.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.07 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.08 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Flex Pression, Ltd.
4. Flex-Weld Incorporated.
5. Hyspan Precision Products, Inc.
6. Mercer Gasket & Shim, Inc.
7. Metraflex, Inc.
8. Proco Products, Inc.
9. TOZEN Corporation.
10. Unaflex.Universal Metal Hose; a Hyspan company.

- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.09 FLOW METERS

- A. Water Flow Monitoring (Cold water service)
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ONICON Incorporate, F-4600 series
 - 2. Siemens
 - 3. SeaMetrics Inc.
 - 4. Niagara Meters.
- C. Description: direct beam wetted ultrasonic transducers, temperature sensor, mounting hardware and calibration certificate.
- D. Construction: Flowmeter shall consist of a drop forged corrosion resistant metal flow body with process connections, integral transducers and a processor / transmitter. All wetted materials shall be NSF 372 compliant.
- E. Pressure Rating: 450 psig minimum.
- F. Temperature Rating: 200 deg F minimum.
- G. Display: Remote mounted electronics, visual instantaneous rate of flow, with register to indicate total volume in gallons.
- H. BMS input for rate of flow and total volume.
- I. Accuracy: minimum 2 percent.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Provide calibrated balancing valves for water heater circulation balance and thermostatic zone valve for hot water branch balancing.
- B. Install balancing valves in locations where they can easily be adjusted.

- C. Thermostatic Zone Valve: (Hot water circulation branch piping) All balance valves must be accessible. Locate lavatory and lavatory group balance valves above ceilings in areas where valves are accessible without access doors. Install balance valve below lavatory with access door or within lavatory enclosure where ceiling access is not available. Do not install ceiling access door unless noted on plans.
 - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- D. Install water-hammer arresters in water piping according to PDI-WH 201.
 - 1. Provide water hammer arrestor on cold-water supply piping to sensor operated drinking fountains with bottle fillers. Typical at all
 - 2. Provide water hammer arrestor on cold-water supply piping to individual or group flush valves.

3.02 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3.03 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

- A. Perform the following test and inspections:
 - 1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION

PART 1 - GENERAL

1.01 GENERAL

- A. Work of this section shall be governed by the Contract Documents. Provide materials, labor, equipment and services necessary to furnish, deliver and install all work of this Section as shown on the drawings, as specified herein, and/or as required by job conditions.
- B. Drawings are diagrammatic and indicate a general arrangement of work. General design concepts indicated must be followed or bettered. The bid shall include offsets, additional piping, valves and plumbing equipment and components as required to meet construction conditions for proper operation. Do not scale drawings. Consult Architectural and Structural drawings for space conditions and additional fixtures. Develop and submit coordination drawings as outlined in Division 22 sections.
- C. The work under this Section shall include all incidentals, labor, material, equipment, appliances, services, hoisting, scaffolding, supports, tools, consumable items, fees, licenses, and administrative tasks required to complete and make operable the plumbing work as intended.
- D. The Contractor shall furnish and install all equipment as necessary to provide a complete installation including coordination, system check out and start up on each item and system.
- E. This Contractor shall inform himself from the general construction specifications and plans, of the exact dimension of finished work and of the height of finished ceilings in all rooms where equipment or pipes are to be placed and arrange his work in accordance with the schedule of interior finishes, as indicated on the architectural drawings.
- F. Manufacturer's qualifications: firms regularly engaged in the manufacture of fixtures, appliances, pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- G. Material qualifications: shall conform to all local, state, and national/federal codes and regulations which may apply and nothing in these specifications shall be interpreted as an infringement of such codes or regulations.
- H. Welding: qualify welding procedures, welders, and operators in accordance with ASME B31.1, or ASME B31.9, as applicable. Certify welding of piping work using Standard Procedure Specifications by, and welders tested under supervision of, National Certified Pipe Welding Bureau (NCPWB).
- I. Brazing: certify brazing procedures, brazers, and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, for shop and job-site brazing of piping work.

1.02 LEAD-FREE STATEMENT

- A. Several plumbing fixtures described in this section fall under jurisdiction of the Federal Reduction of Lead in Drinking Water Act (42 USC 300G) which mandates that effective January 4, 2014 the wetted surfaces of any valve, fitting or fixture that comes in contact with potable water must have a weighted-average lead content of no more than 0.25 percent. The contractor shall be responsible for providing products that are Lead-Free products and meet the requirements of Safe Drinking Water Act Section 1417 (e) (Section 9 of NSF/ANSI Standard 61) and **authorities** having jurisdiction.

1.03 RELATED DOCUMENTS

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

1.04 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Grout.
 - 7. Plumbing demolition.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Painting and finishing.
 - 10. Supports and anchorages.

1.05 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- D. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.

1.06 QUALITY ASSURANCE

- A. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.07 INTENT

- A. It is the intention of the specifications and drawings to provide for finished work, tested and ready for operation.
- B. Items and services not shown on drawings, but mentioned in specifications, or vice versa, or items and services necessary to render the work complete and ready for operation, even if not specified, shall be provided without additional cost.

- C. Where conflicts occur between drawings and specifications, or within either document, the Contractor shall ask for and obtain a written clarification from the Architect prior to submitting his bid. Otherwise, the items or arrangements of superior quality, greater quantity or higher cost shall prevail and be included in the contract price.

1.08 WORK INCLUDED

- A. The work under this Division shall include all labor, material, equipment plant, services and administrative tasks required to complete and make operable the mechanical work shown on the Drawings, required for proper operation and/or specified herein, including but not limited to, the following:
 - 1. Preparation and submission of shop drawings, diagrams and illustrations.
 - 2. Procuring all necessary permits and approvals, and paying all required fees and charges in connection with the work of this Division.
 - 3. Protection, testing, cleaning, adjustment and guarantee of the work of this Division to safely, properly and continuously operate.
 - 4. As-built drawings, operating and maintenance instructions and manuals.
 - 5. Identification labels, tags, charts and diagrams.
 - 6. Maintain existing services to plumbing, etc. (temporary services during construction).
 - 7. Excavation and backfill.
 - 8. Coordination.
 - 9. Project record documents.
 - 10. Operation and Maintenance Data.
 - 11. Cutting and patching.
 - 12. Cooperation with and full participation in the commissioning process.

1.09 WORK NOT INCLUDED

- A. Finish patching of all construction cut under this Division.
- B. Waterproofing of roof penetrations for the work of this Division.
- C. Concrete and masonry work except as specified.
- D. Painting, except as noted.
- E. Removal, patching, or otherwise handling of hazardous materials.

1.10 GENERAL CONFORMANCE

- A. Obtain all general conformances in accordance with Division 1 - General Requirements.
- B. Submit to the Architect for review a list of manufacturers of equipment proposed for the work. Intent to use exact make specified does not relieve the Contractor of responsibility for submitting the required list.
- C. Where any specific materials, process or method of construction, or manufactured article is specified by name or by reference to catalog number of a manufacturer, or other standards, the intent is not to take precedence over the basic duty and performance specified, noted on drawings, or as required for intended results. In all cases, verify the duty specified with the specific characteristics of the equipment offered for review.
- D. Equipment of one type, shall be products of one manufacturer.

- E. Private Label products, equipment and appurtenances shall not be permitted on this project.

1.11 PERMITS AND CERTIFICATES

- A. Prior to proceeding with any installation, prepare and submit to the proper authorities, for their review, all required working drawings. Provide all necessary notices, obtain all permits and pay all local, state and federal taxes, fees and other costs in connection with the work.
- B. The contractor shall be responsible for performing all controlled inspections required by applicable Administrative Building Code.

1.12 DRAWINGS

- A. Drawings are diagrammatic and indicate the general arrangement of systems and work required. Do not scale the Drawings. Consult the architectural drawings and details, and the drawings of other trades, for exact location of equipment.
- B. Drawings shall be used in layout of work. Check reference drawings to verify spaces in which the work will be installed. Maintain maximum headroom and space conditions. Where headroom or space conditions appear inadequate, Architect shall be notified before proceeding with installation.
- C. If directed by the Architect, make minor modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.
- D. The drawings are schematic and diagrammatic.
 - 1. Symbols and diagrams are used to indicate the various items of work and the complete systems, but not necessarily have dimensional significance, neither do they necessarily delineate all related and subsidiary parts and equipment.
 - 2. The work shall be installed complete and ready for operation in conformity with the intent expressed on the drawings and in the specifications.
 - 3. Coordinate the work with the requirements of the architectural and structural drawings for dimensions, locations and clearances.
 - 4. Locations of items exposed to view shall be taken from the architectural drawings or located as directed.

1.13 EQUIPMENT DEVIATIONS

- A. It is the intent of these specifications that wherever a manufacturer of a product or a catalog number is specified, and terms "or equal" or "or approved equal" are used, the substituted item must conform in all essential respects to the specified item including operating efficiency, noise generated, and method of operation. Consideration will not be given claims that the substituted item meets performance requirements with lesser construction. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance.
- B. When such approved deviation requires a different quantity and or arrangement of equipment from that specified or indicated on the drawings, provide required equipment, wiring, piping, connections, valves, and structural supports, and any other additional equipment required by the deviation, at no additional cost to the Owner.
- C. When an item of equipment is proposed, other than that detailed or specified on the drawings, which requires any additional equipment or redesign of the structure, partitions, foundations,

pipng, wiring or any other part of the mechanical, electrical, plumbing or architectural design, such costs shall be incurred by the Contractor without cost to the Owner.

- D. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified at no cost to the Owner. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.14 EQUIPMENT AND SYSTEMS CRITERIA

- A. The criteria of design and performance to produce the required operation is based on equipment shown or scheduled.
 - 1. The equipment must conform to the structural design provisions for loads applied to the structure, to the dimensions established by drawings for mechanical spaces and other clearances, and for inlet and outlet locations and proper relationship to associated equipment and piping.
- B. The descriptions cover basic equipment and operation but not all the details of design and construction.
 - 1. The use of singular in descriptions does not limit the quantities of items to be furnished to provide the operation specified. Furnish all equipment required to produce specified performance under installed conditions.
 - 2. Factory wiring, interconnections, piping and connections shall conform to these specifications for the field work.
 - 3. Provide all trim, enclosures and accessories required to make a complete installation.

1.15 SUBMITTALS

- A. Procedure: Prepare and make the submissions listed below and in Division 1.
- B. Shop Drawings: Submit shop drawings of all items proposed to be furnished and installed under this Division.
- C. Manufacturer's Drawings.
 - 1. Equipment listed in each section, include material specifications, operating characteristics and finishes.
- D. Installation Drawings.
 - 1. Coordinated scale drawings of equipment including interconnecting piping and equipment.
 - 2. Coordinate space requirements for equipment and services.
 - 3. Include connections, anchorages and fastenings.
 - 4. Make allowance for clearances for access to and maintenance of equipment.
- E. Wiring and Control Diagrams.
 - 1. Electric wiring diagrams and automatic control diagrams and sequences of operation. The wiring diagrams must be complete and coordinated with the equipment actually installed.

- F. Provide composite shop drawings showing work of all related construction, when required to ensure full coordination and proper fitting of the work, and when directed by the Architect.
- G. Provide drawings showing dimensions and locations of concrete work required.
- H. Samples.
 - 1. Color samples for prefinished items.
- I. Reports:
 - 1. Manufacturer's certified pressure tests on vessels.
 - 2. Manufacturer's certified performance tests on operating equipment.
 - 3. Field pipe testing reports and certificates of approval.
 - 4. Welder's certificates and field test report.
 - 5. Field operating test results for operating equipment.
 - 6. Performance report on balancing of systems.
 - 7. Performance report and calculations for vibration isolation equipment.
 - 8. Manufacturer's certified reports on motorized equipment alignment and installation.
- J. If submissions of catalog cuts of standard manufactured items show different types, options, finishes, performance requirements, or variations, those features proposed shall be clearly identified.
 - 1. If any variations from the catalog description are proposed or required, such variations must be clearly noted on the cut.
 - 2. Shop drawings shall clearly indicate all details, sectional views, arrangements, working and erection dimensions, kinds and quality of materials and their finishes, and information necessary for proper checking and for fabrication and installation of the items, and shall include all information required for making connections to other work.
 - 3. Shop drawings shall be numbered consecutively, and drawings related to various units comprising a proposed assembly shall be submitted simultaneously so that units may be checked individually and as an assembly.
 - 4. Keep on the site, in good order, a complete up-to-date set of approved shop drawings. All shop drawings shall be available for inspection by the Architect.
 - 5. On product data submittals, clearly indicate model numbers, dimensions, weights, electrical requirements, accessories and performance data. Submittals not properly prepared will be rejected without further review.
 - 6. The review of shop drawings will be general, and shall not be construed as permitting any departure from the contract requirements other than those specifically brought to the Architect's attention and so approved.
 - a. If the shop drawings show any variations from contract requirements because of standard shop practices or reasons, such variations shall be clearly identified on the drawings in order that, if acceptable, suitable action may be taken for proper adjustment in other work affected thereby.
 - b. Failure to identify such variations will not relieve the Contractor of responsibility for executing the work in accordance with the Contract even though such shop drawings have been reviewed and the work installed.
 - c. Review shall not relieve the Contractor of responsibility for any error in details, dimensions, etc., that may exist on shop drawings nor for the furnishing of materials or work required by the Contract and not indicated on the shop drawings.
 - d. Review shall not be construed as acceptable departure from details or instructions previously furnished by the Architect.

- e. Review with a requirement for resubmission is a review contingent upon satisfactory resubmission within 30 days. Failure to comply shall result in a revocation of the contingent review.

K. Shop Drawing Schedule

- 1. The Contractor shall submit, within 30 days of the award of his contract, a schedule of all proposed shop drawing submissions.
- 2. The schedule shall include the following information.
 - a. Item to be submitted
 - b. Date of submission
 - c. Latest date for review
 - d. Manufacturers of the specified item.
- 3. Items not specifically listed as "approved equal" should be listed for consideration at this time.
- 4. Shop drawings require a minimum of 10 business days from the date they have been received by the Consulting Engineer's office to adequately review the submittal. If there is any submittal which requires to be expedited sooner than the 10 business days, the Engineer shall be informed in writing at the beginning of construction with a list of those submittals.

L. Submittals will be reviewed for conformance with the contract drawings and specifications. The engineer's review stamp will be affixed to submittals. One of the following actions will be taken:

- 1. Reviewed:
 - a. No comments, corrections, or marks have been made to the submittal. Re-review by the engineer is not required. The submittal is in general conformance with the design concept. Construction, fabrication and/or manufacture can proceed subject to the provision that the work shall be in accordance with the requirements of the Contract Documents. Final acceptance of the work shall be contingent upon such compliance.
- 2. Furnish As Corrected
 - a. Comments, corrections, or marks made. Re-review is not required. Submission is in general conformance with the design concept subject to notations on the returned Submittal. Construction, fabrication, and/or manufacturer can proceed subject to the provisions that the work shall be carried out in compliance with all annotations and/or corrections indicated on the returned Submittal and in accordance with the Contract Documents. Final acceptance of the work shall be contingent on such compliance.
- 3. Revise and Resubmit
 - a. Significant issues/discrepancies/incomplete information was provided in the Submittal. Revise or prepare a new submittal in accordance with the notations and Contract Documents. Resubmit without delay.

4. Rejected

- a. Submittal does not meet Contract document intent. Revise or prepare a new submittal in accordance with the notations and Contract Documents. Resubmit without delay.

M. A submittal review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the shop drawings during this review do not relieve the contractor from Compliance with the requirements of the plans and specifications. Approval of a specific item shall not include approval of an assembly of which the item is a component. The contractor is responsible for: dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination of his or her work with that of all other trades; and for performing all work in a safe and satisfactory manner.

1.16 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.17 COORDINATION WITH OTHER TRADES

- A. Closely schedule the work so that work will be installed at the proper time without delaying the completion of the entire project.
- B. Where the work will be installed in close proximity to the work of other trades, or where there is evidence that the work will interfere with the work of other trades, arrange space conditions to make a satisfactory adjustment. If work is installed before coordinating with other trades, make necessary changes to the work to correct the condition without additional cost to the owner.
- C. Prepare complete set of drawings showing all necessary slab openings and structural supports that require structural framing. Drawings shall clearly indicate sizes and location relative to established column lines. Drawings shall be completed in sufficient time to allow for structural steel fabrication so as not to delay project schedule.
- D. Shop drawing submissions shall demonstrate a knowledge of the work of other trades, and shall show the locations of the work of other trades which affects the work of this contract.

1.18 COORDINATION DRAWINGS

- A. Develop and submit coordination drawings as outlined.
- B. Sheet metal, plumbing and fire protection shop drawings that have been coordinated with architectural and structural drawings shall be submitted to engineer for review. Drawings must be returned from engineer either "reviewed" or "furnish as corrected" prior to being used as basis for coordination drawings.

- C. After sheet metal and piping drawings have been revised per engineers comments, reproducible copies shall be sent to the others trades in the following sequence for the inclusion of their work:
 - 1. Mechanical sheet metal
 - 2. Plumbing contractor
 - 3. Electrical work
 - 4. Mechanical piping
 - 5. Sprinkler piping
- D. After all trades have included their work on the coordination drawing and noted conflicts, all trades shall meet to resolve conflicts and agree to acceptable solutions. Each trade shall sign coordination drawings. Items not shown on coordination drawing is responsibility of omitting contractor and contractor is subject to additional costs incurred by other trades.
- E. The architect and engineer are not part of the coordination drawing process. The engineer will provide assistance for noted conflicts only. Coordination drawings are not to be considered piping or duct shop drawings. The contractor is required to submit individual piping and ductwork shop drawings for review by the engineer. Piping and ductwork shop drawings shall follow the design intent of the contract documents.
- F. Submit final signed coordination drawing to engineer for review. Engineer will review coordination drawings for general arrangement and for noted conflicts only. Specific installation requirements will be reviewed only in individual trade shop drawings.
- G. Any work fabricated or installed prior to sign off by all trades which is deemed to be in conflict with coordination drawings shall be removed and re-installed in conformance with coordination drawings.
- H. Each contractor (mentioned above) is responsible for the coordination of his sub-contractors.
- I. The overall coordination of the coordination process is the responsibility of the contractor. The engineer is not responsible for the coordination process. The engineer will respond to questions that arise from the coordination process. Drawings submitted will be reviewed for clearly identified conflicts only. Solutions to conflicts will not bear additional cost.
- J. Drawings shall be submitted in both hard copy and electronic (AutoCAD or Revit version as required by the Owner) version or AutoCAD Version 2010 if not specified. Number of copies of each as requested by the Owner.
- K. Electronic drawing files shall be generated by the Contractor. If requested, electronic files of the mechanical floor plans, sections and elevations only will be made available. Electronic files will be released only upon receipt of the signed Agreement for Transfer of Electronic File Data, Agreement for Transfer of Building Information Model and all fees indicated therein.

1.19 AS-BUILT/RECORD DRAWINGS

- A. Provide a complete set of as-built drawings reflecting as installed conditions. As-built drawings shall indicate all installed conditions of systems within this discipline. Drawings shall be of similar scale as the construction documents and include details as necessary to clearly reflect the installed condition. Drawings shall be bound in a complete and consecutive set. Supplemental sketches and loose paperwork will not be acceptable and will be returned for revision. The contractor shall comply with the engineer's comments to produce a clear and concise set of drawings.

- B. Provide "as-built drawings" indicating in a neat and accurate manner a complete record of all revisions of the original design of the work.
- C. Drawings shall be submitted in both hard copy and electronic (AutoCAD and Revit version as required by the Owner) version or AutoCAD Version 2010 if not specified. Number of copies of each as requested by the Owner. PDF's inserted into an AutoCad file are not acceptable.
 - 1. Indicate the following installed conditions:
 - a. Include all changes and an accurate record, on reproductions of the contract drawings or appropriate shop drawings, of all deviations, between the work shown and work installed.
 - b. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart.
 - c. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - d. Approved substitutions, contract modifications, and actual equipment and materials installed.
 - e. Contract modifications, actual equipment and materials installed.
 - f. Submit for review bound sets of the required drawings, manuals and operating instructions.
 - g. Submit a complete maintenance manual of all equipment installed under this contract.

1.20 GUARANTEES AND SERVICES

- A. All workmanship, installation materials and equipment shall be maintained and serviced for the guarantee period at no additional cost to the Owner.
- B. Leave entire system installed under this Contract in perfect working order, and, without additional charge, replace any work or material which develops defects within the guarantee period, including all other work damaged as a result of such defects.
- C. Manufacturers' Warranties
 - 1. The manufacturer shall warrant that the equipment which he has furnished is free from defects in material and workmanship. Obligations under this warranty shall be as follows:
 - a. The equipment manufacturer or supplier shall provide and pay for all labor, parts, accessories, materials, freight and other services to repair or replace any equipment or part thereof which, in the course of installation, start-up and testing is found to be defective.
 - b. For a period of **eighteen months** from the date of acceptance by the Owner, the manufacturer shall replace any defective equipment or part thereof; freight costs for return of defective parts, labor for parts replacement, and replacement of lost refrigerant, are the responsibility of the installing contractor.
 - c. The manufacturer shall provide an additional warranty on all equipment as indicated in their respective specification section.
 - d. Performance - where equipment is specified by size, guarantee that it will have the capacity specified in the system in which it is installed.

2. The final acceptance of the equipment will be made after the manufacturer has adjusted his equipment, balanced the various systems, demonstrated that it fulfills the requirements of the drawings and specifications, and has furnished all the required certificates of inspection and acceptance.

1.21 SYSTEM MAINTENANCE

- A. Contractor shall provide routine and preventive maintenance during the warranty period.
- B. Contractor shall submit to Engineer for review a comprehensive plan covering items to be maintained and service to be performed. Plan shall include checklist for use by maintenance personnel.
- C. Owner's representative(s) shall accompany contractors' maintenance personnel, and receive instructions on proper maintenance of equipment.
- D. Maintenance performed shall include a complete check out of each piece of equipment at least twice during warranty period. The first shall occur approximately half way through the warranty period (change of season) and the second at the conclusion of the warranty period and prior to commencement of the owner's maintenance. Each system and/or piece of equipment shall be inspected, operated through its complete range of operation, and adjusted as required. This inspection shall be the same as performed at the initial start-up of the item or system. In addition, there shall be monthly maintenance inspections of each piece of equipment.
- E. During the monthly inspections, equipment shall be checked for items such as dirty filters, belt wear, lubrication, unusual sounds or unusual operating conditions. Monthly inspections shall also include recording of system operating temperatures and pressures.
- F. Contractor shall include all labor and material to perform the maintenance, including replaceable items such as filters and belts.
- G. Maintenance on the following items shall be included:
 1. Valves

1.22 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In 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.

2.02 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Furnish manufacturers operating and maintenance instructions, parts lists and sources of supply for replacements.
- B. Provide the following:
 - 1. Complete sets of final and correct shop drawings, maintenance and replacement parts manuals, and operating instructions, for equipment supplied.
 - 2. Bind each set within a common binder. Index and organize with a table of contents, to permit quick and convenient reference.
 - 3. Three days of instruction in operation and maintenance of equipment to Owner's maintenance force. Design a 2-week period, convenient to Owner, during which qualified personnel, including manufacturers' technicians and engineers will be available for Owner's instruction.
- C. Master Operating Manual (submit in quadruplicate)
 - 1. Complete sets of final and correct shop drawings, maintenance and replacement parts manuals, and operating instructions, for equipment supplied.
 - 2. Manufacturer's mechanical and electrical equipment parts lists of all components of the systems listed on the equipment schedules, control diagrams and wiring diagrams of controllers.
 - a. List shall give system number, unit number, manufacturer's model number, and manufacturer's drawing numbers.
 - 3. Step by step operating instructions for each system including preparation for starting, summer operation, winter operation, shutdown and draining.
 - 4. Maintenance instructions for each type of equipment.
 - 5. List of nearest local suppliers for all equipment.
 - 6. Manufacturer's literature describing each piece of equipment listed on the equipment schedules, control diagrams and wiring diagrams of controllers and a copy of the air balance report.
 - 7. As-installed control diagrams by the control manufacturer.
 - 8. Description of sequence operation by the control manufacturer.
 - 9. Recommended trouble shooting procedures in the event of foreseeable mechanical system failure.

PART 3 - EXECUTION

3.01 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.

- 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. All underground piping shall be laid on a 6" sand bed and backfilled with clean fine earth compacted to 12" above pipe. Complete backfill with available earth free of large boulders and sharp rocks. Tamp backfill in 6" elevations and overfill to allow for settlement.
- 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 specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping to permit valve servicing.
- H. Install piping at indicated slopes.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install piping to allow application of insulation.
- L. Select system components with pressure rating equal to or greater than system operating pressure.
- M. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- N. Verify final equipment locations for roughing-in.

- O. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.03 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.04 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 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.

3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install 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.
- D. Install equipment to allow right of way for piping installed at required slope.

3.06 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.07 COORDINATION AND LAYOUT

- A. Study Drawings and Specifications to insure completeness of work required.
 - 1. Include supplementary items normal to manufacturers' requirements or standard accepted trade practices as necessary to complete work, though not specifically indicated or specified.
- B. Verify measurements and conditions in field before starting work.
- C. Examine materials to which work is to be applied and notify the Architect, in writing, of any conditions existing, which are detrimental to proper and expeditious installation of work.
 - 1. Starting of work shall be construed as acceptance of conditions.
- D. Confer with other trades, install work to avoid interference with other trades, and possible necessary adjustments to conform to structural conditions and work of other trades.
- E. Coordinate and set inserts and locate openings in floors and walls in new construction.
 - 1. Locate pipes to avoid interference with other work shown on the drawings and as directed by the Architect.
 - 2. Keep all concealed pipes within the enclosing construction provided.
 - 3. Arrange exposed work neatly in parallel runs and parallel with walls or structure, with uniformly spaced hangers and supports, and within the spaces assigned for each kind of work.

- F. Make coordinated layouts showing concrete work required for housekeeping pads, equipment bases and inertia masses, which are cast in place, including the location of anchors and dowels.
 - 1. Coordinate the scheduling and placing of the concrete to suit the mechanical work schedules.
 - 2. Concrete housekeeping pads are to cover the full area of each piece of equipment.
 - 3. Concrete bases are to be of dimension and heights to suit the equipment.
 - 4. The forming and placing of concrete will be provided under this specification section.

3.08 MAINTENANCE OF EQUIPMENT AND SYSTEM PRIOR TO FINAL ACCEPTANCE

- A. Maintain all equipment and systems installed until final acceptance by the Architect and the Owner, and take such measures as necessary to insure adequate protection of all equipment and materials during delivery, storage, installation and shut-down conditions.
 - 1. This responsibility shall include all provisions required to meet the conditions incidental to the delays pending final test of systems and equipment.
- B. After installation of systems has been completed, operate the system to determine the capability of the equipment and controls to conform to the requirements of the drawings and specifications prior to performance testing.

3.09 EQUIPMENT INSTALLATION

- A. Locate and set equipment anchor bolts, dowels and aligning devices for all equipment requiring them. Refer to concrete work coordination.
 - 1. Level the equipment and grout solid between the equipment and the surface below. Grout to be premixed Embeco or Five Star Grout mixed in accordance with manufacturer's specifications.
- B. The field assembly, installation and alignment of equipment is to be done under field supervision provided by the manufacturer or with inspections, adjustments and reviewed by the manufacturer.
- C. Equipment startup.
 - 1. Each manufacturer of equipment shall provide qualified personnel to inspect, review and to supervise the operating tests of the equipment.
- D. Equipment and system test operation.
 - 1. Notify the Architect in advance of beginning the equipment and system test operation.
 - 2. Each piece of equipment shall be operated in its system as long as required to provide proper functioning.
 - 3. Perform an operating test of each complete system for twenty-four hours continuous operation as a minimum, or as long as required to provide coordination and proper functioning of all related systems and controls.
 - 4. The operating criteria for each test shall be determined in advance with the Architect's acceptance whenever seasonal conditions will not produce a full design load on any equipment or system.
 - 5. Certify to the Owner that all equipment is functioning properly.
 - 6. Should the apparatus fail to meet the contract requirements, adjust, repair or replace all defective or inoperative parts and again conduct the complete performance tests.

3.10 CLEANING AND ADJUSTING

- A. Blow out, clean and flush each system of piping, and equipment as required to thoroughly clean the systems.
 - 1. Clean all materials and equipment, and leave in condition ready to operate and receive succeeding finishes where required.
 - 2. Adjust and align all equipment interconnected with couplings or belts.
 - 3. Adjust valves of all types and operating equipment of all types to provide proper operation.
 - 4. Clean all strainers.
- B. Lubricate equipment as recommended by the manufacturer, during temporary construction use, and provide complete lubrication just prior to acceptance.
- C. Permanent equipment operated during construction shall not be abused or be used in service different from its design application.
- D. Equipment furnished with factory finishes shall be retouched and repainted as required to present a new appearance.
- E. Provide and maintain protection for all of the work whether completed or in progress.
 - 1. Provide coverings and enclosures as required.
- F. New and existing operating equipment and systems shall be clean and dust free inside and out.
 - 1. Concealed and unoccupied areas such as plenums, pipe and duct spaces and Equipment Rooms shall be free of rubbish and swept clean at time of acceptance.

3.11 TESTING AND BALANCING

- A. Tests shall be performed in accordance with Division 1 - General Requirements, and the following.
- B. Provide the services of an independent water balancing and testing firm which specializes in balancing and testing of plumbing systems, and which is acceptable to the Owner.
 - 1. All instruments used shall be accurately calibrated and maintained in good working order. If requested, the balancing shall be conducted in the presence of the Architect/Owner.
- C. Balancing shall not begin until the system has been completed and is in full working order.
 - 1. After completion of the balancing and testing submit copies of the results to the Architect.
- D. Perform tests and make necessary adjustments to obtain the flow and distribution of water required to produce the operating criteria called for by the contract documents, in accordance with the latest standards of the National Environmental Balancing Bureau and the Associated Air Balance Council.
 - 1. Mark final position of balancing valves.

- E. Upon completion of the installation, test and balance all equipment and systems under field operating conditions to demonstrate its compliance with specification requirements.
 - 1. Submit three copies of the test report to the Architect. Refer to specification sections for details of report requirements.
- F. Should any part of the system fail to meet the contract requirements, adjust, repair or replace all defective or inoperative parts again conduct the complete performance tests.
- G. The Architect and Owner shall be notified, in writing, at least 48 hours prior to scheduled test dates.

3.12 CONNECTIONS TO EQUIPMENT

- A. Provide mechanical connections to equipment and fixtures requiring such connections which are supplied by Owner or under other divisions.
- B. Provide unions, nipples, adapters, valves, flexible connections, and other trim required for final connections for each such fixture or item of equipment, as required for complete and perfect operation.

3.13 WORKMANSHIP

- A. Perform all work in a practical, neat and workmanlike manner with mechanics skilled in work, and using the best practices of the trade involved.
- B. No work shall be concealed until it has been inspected and approved by the Architect.
- C. Workmanship or materials not meeting with requirements of the specifications and drawings and satisfaction of the Architect shall be rejected and immediately replaced in an acceptable manner, without additional cost to the Owner.

3.14 LUBRICATION

- A. All equipment furnished, installed or connected under this division, shall be inspected for proper lubrication when connected and before operation of the equipment is begun.
- B. The Contractor for the work of this division will be held responsible for any damage to equipment that is operated without having been properly lubricated.

3.15 REMOVALS AND RELOCATIONS

- A. All components of abandoned systems and abandoned portions of systems shall be removed, and, unless specifically noted to be relocated and reused, become the Owner's property. Contractor shall dispose of removed materials as directed by the Owner.
- B. Where portions of systems noted for removal remain in use, permanently seal the point of disconnection so as not to interfere with the system operation.
- C. Where interferences between the existing system components and new work require relocation of the existing components to clear that interference, they may be reused, except where specifically noted to the contrary, providing that their condition is noted by the Owner's representative and they are approved by him as equivalent to new.

- D. Where existing system components are required to be replaced, all new components shall be provided.
- E. System components include all accessories, cables, controls, conduits, hangers, bases and supports and outlets.
- F. The work specified under this contract specifically excludes the removal or patching of "hazardous materials." This includes but is not limited to asbestos, PCBs or any other material having been designated by the Environmental Protection Agency as a hazardous material. If this contractor finds anything, which is suspected of being a hazardous material, it should be immediately brought to the Owner's attention.

3.16 USE OF PREMISES AND CLEANING

- A. Remove and dispose of all waste materials and rubbish due to all construction operations under the contract, except as otherwise noted, and keep the building free from rubbish and dirt caused by his and/or his subcontractors' employees.
 - 1. During the entire progress of the work, rubbish removal shall be made frequently so as to prevent any potential safety or health hazard.
- B. Upon completion of the work, remove all protection, paint, putty, and other stains from all fixtures and glass and leave the premises thoroughly broom cleaned.

3.17 CUTTING, ALTERING AND PATCHING

- A. Provide all cutting, chasing, drilling, altering and rough patching required for the work of this division.
 - 1. Including the restoring of existing work cut for or damaged by installation of new work, and where present work is removed.
 - 2. All materials and workmanship required in connection with cutting, altering and rough patching shall match the existing work in every respect.
- B. Do all shoring, bracing, cutting, patching, piecing out, filling in, repairing and refinishing of all present work as made necessary by the alteration and the installation of new work.
- C. All holes and openings occurring in the existing floors after equipment, partitions, floors, steel work, conduits and pipes are removed or installed shall be closed up with materials similar to the adjacent work.
- D. The size and location of items requiring an opening, chase or other provisions to receive it shall be given by the trade requiring same in ample time to avoid undue cutting of any new work to be installed. These provisions shall not relieve the Contractor from keeping informed as to the required opening, chases, etc., nor from responsibility for the correctness thereof, nor for cutting and repairing after the new work is in place.
- E. Include all cutting, repairing and patching in connection with the work that may be required to make the several parts come together properly and fit it to receive or be received by the work of other trades, as shown on the drawings and/or specified, or reasonably implied by the drawings and specifications.
- F. All repairing, patching, piecing-out, filling-in, restoring and refinishing shall be neatly done by mechanics skilled in their trade to leave same in condition satisfactory to the Owner.

- G. Materials and their methods of application for patching shall comply with applicable requirements of the specifications.
 - 1. Materials and workmanship not covered by the specifications and items of work exposed to view adjoining existing work to remain shall conform to similar materials and workmanship existing in or adjacent to the spaces to be altered.
- H. Cutting, repairing and patching shall include all items shown on the drawings, specified in the specifications or required by the installation of new work or the removal of existing work.
- I. Remove partitions, walls, suspended ceilings, etc., as necessary to perform the required alterations or new construction work.
 - 1. Avoid damage to construction and finishes that are to remain.
- J. Protect and be responsible for the existing building, facilities and improvements.
 - 1. Any disturbance or damage to the work, the existing building, and improvements, or any impairments of facilities resulting from the construction operations, shall be promptly rectified, with the disturbed, damaged, or impaired work, restored, repaired or replaced at no extra cost.
- K. All alterations which are not indicated on the drawings nor specified herein but necessary to make good existing work disturbed by reason of the work shall be restored to a condition satisfactory to the Owner.
- L. All holes in masonry floors and walls are to be core drilled.
- M. Disturbed concrete and /or cement floor areas shall be patched with approved type latex mortar.
 - 1. When cement mortar is used for patching, the surfaces shall be depressed a minimum depth of 1".
- N. Reinstall all weather protection work in waterproof manner.
- O. Openings in roofs.
 - 1. Openings in roofs shall be kept properly plugged and caulked at all times, except when being worked on, to preclude the possibility of flooding due to storms or other causes. After completion of work, openings shall be permanently sealed.
- P. Temporary openings.
 - 1. All temporary openings cut in walls, floors or ceilings for pipe or ductwork shall be closed off with transite or an equally non-combustible material except when mechanics are actually working at the particular opening.

3.18 SPECIAL WORKMANSHIP REQUIREMENTS FOR ARCHITECTURALLY EXPOSED SYSTEMS

- A. General: In addition to basic project workmanship requirements specified above, a higher degree of care in systems layout and routing shall be exerted in selected areas, as follows:
 - 1. Architectural Exposures: Note that this project includes locations where systems will be partially or fully exposed to view in finished architectural spaces due either to the intentional omission of ceilings, and/or to the intentional holding back of ceiling edges from walls, for architectural effects. These areas shall receive extra effort and care above and beyond basic project workmanship principles.
- B. Special Workmanship Requirements: In these special areas, comply with the following requirements:
 - 1. Run systems tight to overhead structure whenever possible.
 - 2. In spaces with gaps between ceiling edges and walls, do not run systems down near ceilings. Locate them as high above as feasible.
 - 3. Do not cross under framing members within view of such gaps. Seek alternative routes around or through obstacles.
 - 4. Fasten systems sufficiently often to prevent their visually sagging or drooping between support points.
 - 5. Route systems parallel to walls, framing members, and other elements defining spatial geometries.
 - 6. Change directions orthogonally.
 - 7. Do not run diagonally when traversing horizontal or vertical surfaces.
- C. Rejection of Work: Workmanship and/or materials not complying with the above additional requirements in these special areas to the satisfaction of the Architect shall be rejected and shall be immediately replaced in an acceptable manner without additional cost.

3.19 SHUTDOWN OF EXISTING BUILDING SYSTEMS

- A. Do not interrupt existing services or systems in the building unless absolutely necessary. Such interruptions and interferences must be made as brief as possible and only after coordination with the Owner. The Owner requires a minimum of seven (7) days notice. Obtain prior permission, in writing.
- B. Where the work makes temporary interruptions unavoidable, they shall be made during off hours. "Off hours" shall be dictated by the Owner.
- C. Arrange to work continuously, including overtime, if required, to assure that systems will shut down only during the time actually required to make the necessary connections to existing work.

3.20 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.
- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.

- C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the startup procedure.
- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Work of this Division shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install all work of this Division as shown on the drawings, as specified herein, and/or as required by job conditions.
- B. Requirements given herein may be affected by other related requirements of the project specification. Correlation of the contract requirements is the responsibility of the contractor.
- C. Perform the work in accordance with the above requirements and the provisions of all applicable codes and laws.
- D. Standard Specifications and Abbreviations

- 1. The following abbreviations used in the Specifications refer to organizations publishing specifications and standards. These shall be construed to mean the latest standard adopted and published at the date of advertisement for bids and such specifications are made part of the Contract Documents to the same extent as if written out in full.

ADC-Air Diffusion Council
AHDGA-American Hot Dip Galvanizing Association
AISC-American Institute of Steel Construction
AMCA-Air Moving and Conditioning Association
ANSI-American National Standards Institute
ARI-American Refrigeration Institute
ASHRAE-American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME-American Society of Mechanical Engineers
ASSE-American Society of Sanitary Engineers
ASTM -American Society for Testing Materials
AWS-American Welding Society
AWWA-American Water Works Association
FIA-Factory Insurance Association
FM-Factory Mutual
FS-Federal Specifications
MCAA-Mechanical Contractors Association of America
MSS-Manufacturers Standardization Society of Valve and Fittings Industry
NBFU-National Board of Fire Underwriters
NBS-National Bureau of Standards
NEC-National Electrical Code
NEMA-National Electrical Manufacturers Association
NFPA-National Fire Protection Association
NSF-National Sanitation Foundation
OSHA-Occupational Safety Health Act
PDI-Plumbing and Drainage Institute
PPI-Plastics Pipe Institute
SMACNA-Sheet Metal and Air Conditioning Contractors National Association, Inc.

SSPC-Steel Structures Painting Council
STI-Steel Tank Institute
UL-Underwriters Laboratories, Inc.
USDC-United States Department of Commerce
USPHS-United States Public Health Service

2. Conform to ANSI - 31.1.0 and addenda for basic materials and methods of installation for closed piping systems with pressures in excess of 30 PSI, and for pipe welding regardless of system pressures.
 3. Conform to ASME Boiler and Pressure Vessel Code Section VIII and FM requirements for construction of unfired pressure vessels.
- E. Where the word "provided" is used in this document, it shall be understood to mean, "provided and installed."
- F. [Section 019113 – General Commissioning Requirements.](#)

1.02 SUMMARY

- A. This Section includes the following:
1. Grout.
 2. HVAC demolition.
 3. Equipment installation requirements common to equipment sections.
 4. Painting and finishing.
 5. Concrete bases.
 6. Supports and anchorages.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. 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 above ceilings and chases.
- 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. Where the word "provided" is used in this document, it shall be understood to mean "provided and installed."

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.04 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

1.05 INTENT

- A. It is the intention of the specifications and drawings to provide for finished work, tested and ready for operation.
- B. Items and services not shown on drawings, but mentioned in specifications, or vice versa, or items and services necessary to render the work complete and ready for operation, even if not specified, shall be provided without additional cost.
- C. Where conflicts occur between drawings and specifications, or within either document, the Contractor shall ask for and obtain a written clarification from the Architect prior to submitting his bid. Otherwise, the items or arrangements of superior quality, greater quantity or higher cost shall prevail and be included in the contract price.

1.06 WORK INCLUDED

- A. The work under this Division shall include all labor, material, equipment plant, services and administrative tasks required to complete and make operable the mechanical work shown on the Drawings, required for proper operation and/or specified herein, including but not limited to, the following:
1. Preparation and submission of shop drawings, diagrams and illustrations.
 2. Procuring all necessary permits and approvals, and paying all required fees and charges in connection with the work of this Division.
 3. Protection, testing, cleaning, adjustment and guarantee of the work of this Division to safely, properly and continuously operate.
 4. As-built drawings, operating and maintenance instructions and manuals.
 5. Identification labels, tags, charts and diagrams.
 6. Maintain existing services to heating, etc. (temporary services during construction).
 7. Excavation and backfill.
 8. Coordination.
 9. Project record documents.
 10. Operation and Maintenance Data.
 11. Cutting and patching.
 12. Cooperation with and full participation in the commissioning process.

1.07 WORK NOT INCLUDED

- A. Finish patching of all construction cut under this Division.
- B. Waterproofing of roof penetrations for the work of this Division.
- C. Concrete and masonry work except as specified.
- D. Painting, except as noted.
- E. Removal, patching, or otherwise handling of hazardous materials.

1.08 SITE INVESTIGATION

- A. Examine the drawings and specifications of all trades, and the site, and from these investigations be responsible for the nature and location of work, general and local conditions, particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, roads, etc.

1.09 DRAWINGS

- A. Drawings are diagrammatic and indicate the general arrangement of systems and work required. Do not scale the Drawings. Consult the architectural drawings and details, and the drawings of other trades, for exact location of equipment.
- B. Drawings shall be used in layout of work. Check reference drawings to verify spaces in which the work will be installed. Maintain maximum headroom and space conditions. Where headroom or space conditions appear inadequate, Architect shall be notified before proceeding with installation.
- C. If directed by the Architect, make minor modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.
- D. The drawings are schematic and diagrammatic.
 - 1. Symbols and diagrams are used to indicate the various items of work and the complete systems, but not necessarily have dimensional significance, neither do they necessarily delineate all related and subsidiary parts and equipment.
 - 2. The work shall be installed complete and ready for operation in conformity with the intent expressed on the drawings and in the specifications.
 - 3. Coordinate the work with the requirements of the architectural and structural drawings for dimensions, locations and clearances.
 - 4. Locations of items exposed to view shall be taken from the architectural drawings or located as directed.

1.10 COORDINATION WITH OTHER TRADES

- A. Closely schedule the work so that work will be installed at the proper time without delaying the completion of the entire project.
- B. Where the work will be installed in close proximity to the work of other trades, or where there is evidence that the work will interfere with the work of other trades, arrange space conditions to

make a satisfactory adjustment. If work is installed before coordinating with other trades, make necessary changes to the work to correct the condition without additional cost to the owner.

- C. Prepare complete set of drawings showing all necessary slab openings and structural supports that require structural framing. Drawings shall clearly indicate sizes and location relative to established column lines. Drawings shall be completed in sufficient time to allow for structural steel fabrication so as not to delay project schedule.
- D. Shop drawing submissions shall demonstrate a knowledge of the work of other trades, and shall show the locations of the work of other trades which affects the work of this contract.

1.11 EQUIPMENT DEVIATIONS

- A. It is the intent of these specifications that wherever a manufacturer of a product or a catalog number is specified, and terms "or equal" or "or approved equal" are used, the substituted item must conform in all essential respects to the specified item including operating efficiency, noise generated, and method of operation. Consideration will not be given claims that the substituted item meets performance requirements with lesser construction. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance.
- B. When such approved deviation requires a different quantity and or arrangement of equipment from that specified or indicated on the drawings, provide required equipment, wiring, piping, connections, valves, and structural supports, and any other additional equipment required by the deviation, at no additional cost to the Owner.
- C. When an item of equipment is proposed, other than that detailed or specified on the drawings, (this includes equipment by manufacturers indicated in the specifications) which requires any additional equipment or redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical, electrical, plumbing or architectural design, such costs shall be incurred by the Contractor without cost to the Owner. Redesign, updates, revisions required for any trade as a result of the use of equipment not detailed on the drawings shall be performed and borne by the contractor.
- D. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified at no cost to the Owner. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.12 EQUIPMENT AND SYSTEMS CRITERIA

- A. The criteria of design and performance to produce the required operation is based on equipment shown or scheduled.
 - 1. The equipment must conform to the structural design provisions for loads applied to the structure, to the dimensions established by drawings for mechanical spaces and other clearances, and for inlet and outlet locations and proper relationship to associated equipment, piping and ducts.

- B. The descriptions cover basic equipment and operation but not all the details of design and construction.
1. The use of singular in descriptions does not limit the quantities of items to be furnished to provide the operation specified. Furnish all equipment required to produce specified performance under installed conditions.
 2. Factory wiring, interconnections, piping and connections shall conform to these specifications for the field work.
 3. Provide all trim, enclosures and accessories required to make a complete installation.
- C. Acoustical performance of equipment and systems.
1. Noise levels from operation of motor driven equipment, whether air-borne or structure-borne, and noise levels created by or within air-handling equipment and air distribution and control media shall not exceed sound pressure levels determined by the noise criterion curves in the ASHRAE Guide as follows:

<u>Location</u>	<u>Noise Criterion</u>
Offices	NC 35
Corridors	NC 40
Toilets	NC 40
Classrooms	NC 30
Conference	NC 30
 2. Testing for conformance to the above requirements will be provided by an acoustical consultant retained by the Owner.
 - a. Octave band sound pressure levels will be obtained for ambient room conditions with equipment not operating and also with the installed equipment operating per plans and specifications.
 - b. For testing purposes, sound pressure levels will be measured 3'-0" above the floor.

1.13 GENERAL CONFORMANCE

- A. Obtain all general conformances in accordance with Division 1 - General Requirements.
- B. Submit to the Architect for review a list of manufacturers of equipment proposed for the work. Intent to use exact make specified does not relieve the Contractor of responsibility for submitting the required list.
- C. Where any specific materials, process or method of construction, or manufactured article is specified by name or by reference to catalog number of a manufacturer, or other standards, the intent is not to take precedence over the basic duty and performance specified, noted on drawings, or as required for intended results. In all cases, verify the duty specified with the specific characteristics of the equipment offered for review.
- D. Equipment and material of one type, shall be products of one manufacturer. Multiple manufacturers for like items are not acceptable.

1.14 SUBMITTALS

- A. Manufacturer's Drawings.
 - 1. Equipment listed in each section, include material specifications, operating characteristics and finishes.
- B. Installation Drawings.
 - 1. Coordinated scale drawings of equipment including interconnecting piping and ductwork.
 - 2. Coordinate space requirements for equipment and services.
 - 3. Include connections, anchorages and fastenings.
 - 4. Make allowance for clearances for access to and maintenance of equipment.
- C. Wiring and Control Diagrams.
 - 1. Electric wiring diagrams and automatic control diagrams and sequences of operation. The wiring diagrams must be complete and coordinated with the equipment actually installed.
- D. Provide composite shop drawings showing work of all related construction, when required to ensure full coordination and proper fitting of the work, and when directed by the Architect.
- E. Provide drawings showing dimensions and locations of concrete work required for the mechanical work.
- F. Samples.
 - 1. Color samples for prefinished items.
- G. Reports:
 - 1. Manufacturer's certified pressure tests on vessels.
 - 2. Manufacturer's certified performance tests on operating equipment.
 - 3. Field pipe testing reports and certificates of approval.
 - 4. Welder's certificates and field test report.
 - 5. Field operating test results for operating equipment.
 - 6. Performance report on the balancing of air and water systems.
 - 7. Performance report and calculations for vibration isolation equipment.
 - 8. Manufacturer's certified reports on motorized equipment alignment and installation.
- H. If submissions of catalog cuts of standard manufactured items show different types, options, finishes, performance requirements, or other variations, those features proposed shall be clearly identified.
 - 1. If any variations from the catalog description are proposed or required, such variations must be clearly noted on the cut.
 - 2. Shop drawings shall clearly indicate all details, sectional views, arrangements, working and erection dimensions, kinds and quality of materials and their finishes, and other information necessary for proper checking and for fabrication and installation of the items, and shall include all information required for making connections to other work.

3. Shop drawings shall be numbered consecutively, and drawings related to various units comprising a proposed assembly shall be submitted simultaneously so that units may be checked individually and as an assembly.
4. Keep on the site, in good order, a complete up-to-date set of approved shop drawings. All shop drawings shall be available for inspection by the Architect.
5. On product data submittals, clearly indicate model numbers, dimensions, weights, electrical requirements, accessories and performance data. Submittals not properly prepared will be rejected without further review.
6. The review of shop drawings will be general, and shall not be construed as permitting any departure from the contract requirements other than those specifically brought to the Architect's attention and so approved.
 - a. If the shop drawings show any variations from contract requirements because of standard shop practices or other reasons, such variations shall be clearly identified on the drawings in order that, if acceptable, suitable action may be taken for proper adjustment in other work affected thereby.
 - b. Failure to identify such variations will not relieve the Contractor of responsibility for executing the work in accordance with the Contract even though such shop drawings have been reviewed and the work installed.
 - c. Review shall not relieve the Contractor of responsibility for any error in details, dimensions, etc., that may exist on shop drawings nor for the furnishing of materials or work required by the Contract and not indicated on the shop drawings.
 - d. Review shall not be construed as acceptable departure from details or instructions previously furnished by the Architect.
 - e. Review with a requirement for resubmission is a review contingent upon satisfactory resubmission within 30 days. Failure to comply shall result in a revocation of the contingent review.

I. Shop Drawing Schedule

1. The Contractor shall submit, within 30 days of the award of his contract, a schedule of all proposed shop drawing submissions.
2. The schedule shall include the following information.
 - a. Item to be submitted
 - b. Date of submission
 - c. Latest date for review
 - d. Manufacturers of the specified item.
3. Items not specifically listed as "approved equal" should be listed for consideration at this time.
4. Shop drawings require a minimum of 10 business days from the date they have been received by the Consulting Engineer's office to adequately review the submittal. If there is any submittal which requires to be expedited sooner than the 10 business days, the Engineer shall be informed in writing at the beginning of construction with a list of those submittals.

J. Submittals will be reviewed for conformance with the contract drawings and specifications.

- K. The engineer's review stamp will be affixed to submittals. One of the following actions will be taken:
1. Reviewed:
 - a. No comments, corrections, or marks have been made to the submittal. Re-review by the engineer is not required. The submittal is in general conformance with the design concept. Construction, fabrication and/or manufacture can proceed subject to the provision that the work shall be in accordance with the requirements of the Contract Documents. Final acceptance of the work shall be contingent upon such compliance.
 2. Furnish As Corrected
 - a. Comments, corrections, or marks made. Re-review is not required. Submission is in general conformance with the design concept subject to notations on the returned Submittal. Construction, fabrication, and/or manufacturer can proceed subject to the provisions that the work shall be carried out in compliance with all annotations and/or corrections indicated on the returned Submittal and in accordance with the Contract Documents. Final acceptance of the work shall be contingent on such compliance.
 3. Revise and Resubmit
 - a. Significant issues/discrepancies/incomplete information was provided in the Submittal. Revise or prepare a new submittal in accordance with the notations and Contract Documents. Resubmit without delay.
 4. Rejected
 - a. Submittal does not meet Contract document intent. Revise or prepare a new submittal in accordance with the notations and Contract Documents. Resubmit without delay.
- L. A submittal review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the shop drawings during this review do not relieve the contractor from Compliance with the requirements of the plans and specifications. Approval of a specific item shall not include approval of an assembly of which the item is a component. The contractor is responsible for: dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination of his or her work with that of all other trades; and for performing all work in a safe and satisfactory manner.

1.15 GUARANTEES AND SERVICES

- A. All workmanship, installation materials and equipment shall be maintained and serviced for the guarantee period at no additional cost to the Owner.
- B. Leave entire system installed under this Contract in perfect working order, and, without additional charge, replace any work or material which develops defects within the guarantee period, including all other work damaged as a result of such defects.

- C. Non-durable, expendable items such as air filter media are not subject to replacement after the date of acceptance.
- D. The guarantee period shall be extended as follows:
 - 1. For heating systems, one year plus the time necessary to include one continuous heating season from November 1st to April 1st.
 - 2. For air-conditioning systems, one year plus the time necessary to include one continuous cooling season from May 1st to October 1st.
- E. Manufacturers' Warranties
 - 1. The manufacturer shall warrant that the equipment which he has furnished is free from defects in material and workmanship. Obligations under this warranty shall be as follows:
 - a. The equipment manufacturer or supplier shall provide and pay for all labor, parts, accessories, materials, freight and other services to repair or replace any equipment or part thereof which, in the course of installation, start-up and testing is found to be defective.
 - b. For a period of eighteen months from the date of acceptance by the Owner, the manufacturer shall replace any defective equipment or part thereof; freight costs for return of defective parts, labor for parts replacement, and replacement of lost refrigerant, are the responsibility of the installing contractor.
 - c. The manufacturer shall provide an additional warranty on all equipment as indicated in their respective specification section.
 - d. Performance - where equipment is specified by size, guarantee that it will have the capacity specified in the system in which it is installed.
 - 2. The final acceptance of the equipment will be made after the manufacturer has adjusted his equipment, balanced the various systems, demonstrated that it fulfills the requirements of the drawings and specifications, and has furnished all the required certificates of inspection and acceptance.

1.16 SYSTEM MAINTENANCE

- A. Contractor shall provide routine and preventive maintenance during the warranty period.
- B. Contractor shall submit to Engineer for review a comprehensive plan covering items to be maintained and service to be performed. Plan shall include checklist for use by maintenance personnel.
- C. Owner's representative(s) shall accompany contractors' maintenance personnel, and receive instructions on proper maintenance of equipment.
- D. Maintenance performed shall include a complete check out of each piece of equipment at least twice during warranty period. The first shall occur approximately half way through the warranty period (change of season) and the second at the conclusion of the warranty period and prior to commencement of the owner's maintenance. Each system and/or piece of equipment shall be inspected, operated through its complete range of operation, and adjusted as required. This inspection shall be the same as performed at the initial start-up of the item or system. In addition, there shall be monthly maintenance inspections of each piece of equipment.

- E. During the monthly inspections, equipment shall be checked for items such as dirty filters, belt wear, lubrication, unusual sounds or unusual operating conditions. Monthly inspections shall also include recording of system operating temperatures and pressures.
- F. Contractor shall include all labor and material to perform the maintenance, including replaceable items such as filters and belts.
- G. Maintenance on the following items shall be included:
 - 1. Fans
 - 2. Air handling units
 - 3. Filters
 - 4. Temperature controls
 - 5. Unit and Cabinet Heaters
 - 6. Actuators

1.17 PERMITS AND CERTIFICATES

- A. Prior to proceeding with any installation, prepare and submit to the proper authorities, for their review, all required working drawings. Provide all necessary notices, obtain all permits and pay all local, state and federal taxes, fees and other costs in connection with the work.
- B. The contractor shall be responsible for performing all controlled inspections required by applicable Administrative Building Code.

1.18 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."
- D. It is the intent of these specifications that wherever a manufacturer of a product or a catalog number is specified, and terms "or equal" or "or approved equal" are used, the substituted item must conform in all essential respects to the specified item including operating efficiency, noise, physical size, capacity, quality, and material.

1.19 COORDINATION DRAWINGS

- A. Sheet metal and plumbing shop drawings that have been coordinated with architectural and structural drawings shall be submitted to Engineer for review. Drawings must be returned from Engineer either "Reviewed" or "Furnish as corrected" prior to being used as basis for coordination drawings. Refer to Section 233113 for sheet metal shop drawing and 232113 for piping shop-drawing requirements.

- B. The contractor shall submit for review sheet metal shop standards. Any sheet metal shop drawings submitted prior to the submission of the shop standards shall be returned "not reviewed".
- C. After sheet metal and piping drawings have been revised per Engineers comments, reproducible copies shall be sent to the others trades in the following sequence for the inclusion of their work:
 - 1. Plumbing contractor
 - 2. Electrical work
 - 3. Mechanical piping
 - 4. Sprinkler piping
- D. After all trades have included their work on the coordination drawing and noted conflicts, all trades shall meet to resolve conflicts and agree to acceptable solutions. Each trade shall sign coordination drawings. Items not shown on coordination drawing is responsibility of omitting contractor and contractor is subject to additional costs incurred by other trades.
- E. The Architect and Engineer are not part of the coordination drawing process. The Engineer will provide assistance relative to acceptability of installations.
- F. Submit final signed coordination drawing to engineer for review. Engineer will review for acceptability of installations.
- G. Any work fabricated or installed prior to sign off by all trades shall be removed and re-installed in conformance with coordination drawings.
- H. Each contractor (mentioned above) is responsible for the coordination of his sub-contractors.
- I. The overall coordination of the coordination process is the responsibility of the general contractor and/or construction manager.
- J. The overall coordination of the coordination process is the responsibility of the general contractor and/or construction manager. The Engineer is not responsible for the coordination process. The Engineer will respond to questions that arise from the coordination process. Drawings submitted will be reviewed for clearly identified conflicts only. Solutions to conflicts will not bear additional cost.
- K. Drawings shall be submitted in both hard copy and electronic (AutoCAD or Revit version as required by the Owner) version or AutoCAD Version 2018 if not specified. Number of copies of each as requested by the Owner.
- L. Electronic drawing files shall be generated by the Contractor.

1.20 AS BUILT DRAWINGS/RECORD DRAWINGS

- A. Provide a complete set of as-built drawings reflecting as installed conditions. As-built drawings shall indicate all installed conditions of systems within this discipline. Drawings shall be of similar scale as the construction documents and include details as necessary to clearly reflect the installed condition. Drawings shall be bound in a complete and consecutive set. Supplemental sketches and loose paperwork will not be acceptable and will be returned for

revision. The contractor shall comply with the engineer's comments to produce a clear and concise set of drawings.

- B. Provide "As-Built Drawings" indicating in a neat and accurate manner a complete record of all revisions of the original design of the work.
 - 1. Drawings shall be submitted in both hard copy and electronic (AutoCAD and Revit version as required by the Owner) version or AutoCAD Version 2018 if not specified. Number of copies of each as requested by the Owner. PDFs inserted into an AutoCad file are not acceptable.
 - 2. Indicate the following installed conditions:
 - a. All changes and an accurate record from the contract drawings or appropriate shop drawings, of all deviations, between the work shown and work installed.
 - b. Ductwork mains and branches, size and location; locations of dampers and other control devices; filters, boxes, coils and terminal units requiring periodic maintenance or repair.
 - c. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart.
 - d. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - e. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
 - f. Contract modifications, actual equipment and materials installed.
 - g. Submit for review bound sets of the required drawings, manuals and operating instructions.
 - 3. Electronic drawing files shall be generated by the Contractor.

PART 2 - PRODUCTS

2.1 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Furnish manufacturers operating and maintenance instructions, parts lists and sources of supply for replacements in accordance with Division 1 - General Requirements.
- B. Provide the following:
 - 1. Complete sets of final and correct shop drawings, maintenance and replacement parts manuals, and operating instructions, for equipment supplied.
 - 2. Bind each set within a common binder. Index and organize with a table of contents, to permit quick and convenient reference.
 - 3. Three days of instruction in operation and maintenance of equipment to Owner's maintenance force. Design a 2-week period, convenient to Owner, during which qualified personnel, including manufacturers' technicians and engineers will be available for Owner's instruction.

- C. Master Operating Manual (submit in quadruplicate and as digital PDF document)
1. Complete sets of final and correct shop drawings, maintenance and replacement parts manuals, and operating instructions, for equipment supplied.
 - a. Directory Manual – A TOC for all volumes in the Systems Manual shall be provided. Each heading should include a brief description of contents of each section to help when searching the PDF document.
 - b. Owner's Project Requirements (OPR)
 - c. Basis of Design (BOD)
 - d. Construction Record Documents
 - e. System and equipment operating data / Maintenance Procedures – O&M materials as submitted and approved. This should not be limited to MEP O&M's, but should include all applicable O&M materials through the specified divisions.
 - f. Final ATC as-built documents
 - g. Warranty Manual – A separate manual inclusive of all project warranties Warranty start dates shall be clearly presented and conform with project requirements Warranty claims procedures shall be clearly presented.
 - h. Manual shall be compiled in electronic format, shall be unprotected, and shall be searchable. The documents within this manual shall be easy to navigate provided with table of contents, filed individually tabbed & bookmarked.
 2. Manufacturer's mechanical and electrical equipment parts lists of all components of the systems listed on the equipment schedules, control diagrams and wiring diagrams of controllers.
 - a. List shall give system number, unit number, manufacturer's model number, and manufacturer's drawing numbers.
 3. Step by step operating instructions for each system including preparation for starting, summer operation, winter operation, shutdown and draining.
 4. Maintenance instructions for each type of equipment.
 5. List of nearest local suppliers for all equipment.
 6. Manufacturer's literature describing each piece of equipment listed on the equipment schedules, control diagrams and wiring diagrams of controllers and a copy of the air balance report.
 7. As-installed control diagrams by the control manufacturer.
 8. Description of sequence operation by the control manufacturer.
 9. Recommended trouble shooting procedures in the event of foreseeable mechanical system failure.
 10. Copies of the following test reports:
 - a. Air Balance.
 - b. System Performance.
 - c. Required Pressure Tests.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

- A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.3 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 9 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. Inside of all ductwork where visible through registers and grilles: one coat of flat black paint.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.5 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.6 COORDINATION AND LAYOUT

- A. Study Drawings and Specifications to insure completeness of work required.
 - 1. Include supplementary items normal to manufacturers' requirements or standard accepted trade practices as necessary to complete work, though not specifically indicated or specified.
- B. Verify measurements and conditions in field before starting work.
- C. Examine materials to which work is to be applied and notify the Architect, in writing, of any conditions existing, which are detrimental to proper and expeditious installation of work.
 - 1. Starting of work shall be construed as acceptance of conditions.
- D. Confer with other trades, install work to avoid interference with other trades, and possible necessary adjustments to conform to structural conditions and work of other trades.
- E. Coordinate and set inserts and locate openings in floors and walls in new construction.
 - 1. Locate pipes and ducts to avoid interference with other work shown on the drawings and as directed by the Architect.
 - 2. Keep all concealed pipes and ducts within the enclosing construction provided.

3. Arrange exposed work neatly in parallel runs and parallel with walls or structure, with uniformly spaced hangers and supports, and within the spaces assigned for each kind of work.
- F. Make coordinated layouts showing concrete work required for housekeeping pads, equipment bases and inertia masses, which are cast in place, including the location of anchors and dowels.
 1. Coordinate the scheduling and placing of the concrete to suit the mechanical work schedules.
 2. Concrete housekeeping pads are to cover the full area of each piece of equipment.
 3. Concrete bases are to be of dimension and heights to suit the equipment.
 4. The forming and placing of concrete will be provided under this specification section.

3.7 MAINTENANCE OF EQUIPMENT AND SYSTEM PRIOR TO FINAL ACCEPTANCE

- A. Maintain all equipment and systems installed until final acceptance by the Architect and the Owner, and take such measures as necessary to insure adequate protection of all equipment and materials during delivery, storage, installation and shut-down conditions.
 1. This responsibility shall include all provisions required to meet the conditions incidental to the delays pending final test of systems and equipment.
- B. After installation of systems has been completed, operate the system to determine the capability of the equipment and controls to conform to the requirements of the drawings and specifications prior to performance testing.

3.8 EQUIPMENT INSTALLATION

- A. Locate and set equipment anchor bolts, dowels and aligning devices for all equipment requiring them. Refer to concrete work coordination.
 1. Level the equipment and grout solid between the equipment and the surface below. Grout to be premixed Embeco or Five Star Grout mixed in accordance with manufacturer's specifications.
- B. The field assembly, installation and alignment of equipment is to be done under field supervision provided by the manufacturer or with inspections, adjustments and reviewed by the manufacturer.
- C. Equipment startup.
 1. Each manufacturer of equipment shall provide qualified personnel to inspect, review and to supervise the operating tests of the equipment.
- D. Equipment and system test operation.
 1. Notify the Architect in advance of beginning the equipment and system test operation.
 2. Each piece of equipment shall be operated in its system as long as required to provide proper functioning.
 3. Perform an operating test of each complete system for twenty-four hours continuous operation as a minimum, or as long as required to provide coordination and proper functioning of all related systems and controls.

4. The operating criteria for each test shall be determined in advance with the Architect's acceptance whenever seasonal conditions will not produce a full design load on any equipment or system.
5. Certify to the Owner that all equipment is functioning properly.
6. Should the apparatus fail to meet the contract requirements, adjust, repair or replace all defective or inoperative parts and again conduct the complete performance tests.

3.9 WORK RELATING TO CONTROLS AND INSTRUMENTS

- A. Under Sections 230900 as applicable, provide control wiring for the following:
 1. All circuits actuated by a temperature control system component.
 2. All circuits which actuate a temperature control component.
 3. All control panel wiring to terminal strips and field wiring from terminal strips to field mounted devices.
 4. All wiring from the "AUTO" side of hand-off-auto switches on units being controlled by Sections 230900
 5. Wiring of electro-mechanical devices required to be located on or in temperature control panels.
 6. Wiring of DDC trunk, communication, and sensor cable wiring.
 7. Wiring shall comply with material and workmanship standards of Division 26.
 8. All 120 volt power wiring to vav boxes, damper actuators, line voltage thermostats, valve actuators, relay's, etc. not powered by 24 volt power is work of this division. Wiring shall comply with material and workmanship standards of Division 26.
- B. Under Division 26, perform the following work under supervision of Sections 230900
 1. Wiring of all devices and circuits carrying voltages greater than 120 volts.
 2. Wiring of line and load power feeds to all disconnects, starters, and electric motors.
 3. Wiring of 115 volt power feeds to all temperature control panels.
 4. Power wiring to all motors 110 volt to 480 volt.
 5. Furnish smoke detectors for mounting in ducts.
 6. Specific power feeds shown or specified in Div 26 documents.

3.10 CLEANING AND ADJUSTING

- A. Clean all materials and equipment, and leave in condition ready to operate and receive succeeding finishes where required.
- B. Adjust and align all equipment interconnected with couplings or belts.
- C. Lubricate equipment as recommended by the manufacturer, during temporary construction use, and provide complete lubrication just prior to acceptance.
- D. Permanent equipment operated during construction shall not be abused or be used in service different from its design application.
 1. Temporary disposable filters shall be used during temporary operation.
 2. All expendable media, including belts used for temporary operation and similar expendable materials shall be replaced just prior to acceptance.

- 3. Packing boxes of equipment operated during construction must be replaced just prior to system acceptance, using materials and methods specified by the supplying manufacturer.
- E. Equipment furnished with factory finishes shall be retouched and repainted as required to present a new appearance.
- F. Provide and maintain protection for all of the work whether completed or in progress.
 - 1. Provide coverings and enclosures as required.
- G. New and existing operating equipment and systems shall be clean and dust free inside and out.
 - 1. Concealed and unoccupied areas such as plenums, pipe and duct spaces and Equipment Rooms shall be free of rubbish and swept clean at time of acceptance.

3.11 TESTING AND BALANCING

- A. Tests shall be performed in accordance with Division 1 - General Requirements, and the following.
- B. Provide the services of an independent air balancing and testing firm which specializes in balancing and testing of heating, ventilating and air conditioning systems, and which is acceptable to the Owner.
 - 1. All instruments used shall be accurately calibrated and maintained in good working order. If requested, the balancing shall be conducted in the presence of the Architect/Owner.
- C. Balancing shall not begin until the system has been completed and is in full working order.
 - 1. After completion of the balancing and testing submit copies of the results to the Architect.
- D. Perform tests and make necessary adjustments to obtain the flow and distribution of air and water required to produce the operating criteria called for by the contract documents, in accordance with the latest standards of the National Environmental Balancing Bureau and the Associated Air Balance Council.
 - 1. Occupied spaces shall be draft free upon completion.
 - 2. Provide any necessary baffles at registers and diffusers.
 - 3. Maintain the specified acoustical performance of the systems.
 - 4. Mark final position of dampers and balancing valves.
- E. Upon completion of the installation, test and balance all equipment and systems under field operating conditions to demonstrate its compliance with specification requirements.
 - 1. Submit three copies of the test report to the Architect. Refer to specification sections for details of report requirements.
- F. Should any part of the system fail to meet the contract requirements, adjust, repair or replace all defective or inoperative parts again conduct the complete performance tests.

- G. The Architect and Owner shall be notified, in writing, at least 48 hours prior to scheduled test dates.

3.12 PAINTING

- A. Thoroughly clean all surfaces, requiring prime painting, of rust, loose scale, oil and grease.
 - 1. Dry surfaces before painting.
 - 2. Do not paint controls, nameplates, or labels.
- B. Paint all equipment not painted at the factory with one prime coat.
- C. Provide field painting as follows:
 - 1. All exposed iron work, including uninsulated ferrous piping and conduit system components, hangers, supports, equipment bases, and apparatus; prime coat, red oxide primer.
 - 2. Un-insulated ductwork and casing exposed to view and exposed galvanized surfaces of conduit and piping and of equipment prime painted at the shop as indicated on the drawings to be painted Prime coat, zinc chromate for galvanized surfaces.
 - 3. Inside of all ductwork/plenums where visible through registers and grilles: One coat of flat black paint specifically designed for metal surfaces. Paint shall be low VOC.
 - 4. Inside of all outdoor air intake plenums where visible through louvers: One coat of flat black paint specifically designed for exterior metal surface. Paint shall be low VOC.

3.13 CONNECTIONS TO EQUIPMENT

- A. Provide mechanical connections to equipment and fixtures requiring such connections which are supplied by Owner or under other divisions.
- B. Provide unions, nipples, adapters, valves, flexible connections, and other trim required for final connections for each such fixture or item of equipment, as required for complete and perfect operation.

3.14 WORKMANSHIP

- A. Perform all work in a practical, neat and workmanlike manner with mechanics skilled in work, and using the best practices of the trade involved.
- B. No work shall be concealed until it has been inspected and approved by the Architect.
- C. Workmanship or materials not meeting with requirements of the specifications and drawings and satisfaction of the Architect shall be rejected and immediately replaced in an acceptable manner, without additional cost to the Owner.

3.15 LUBRICATION

- A. All equipment furnished, installed or connected under this division, shall be inspected for proper lubrication when connected and before operation of the equipment is begun.
- B. The Contractor for the work of this division will be held responsible for any damage to equipment that is operated without having been properly lubricated.

3.16 REMOVALS AND RELOCATIONS

- A. All components of abandoned systems and abandoned portions of systems shall be removed, and, unless specifically noted to be relocated and reused, become the Owner's property. Contractor shall dispose of removed materials as directed by the Owner.
- B. Where portions of systems noted for removal remain in use, permanently seal the point of disconnection so as not to interfere with the system operation.
- C. Where interferences between the existing system components and new work require relocation of the existing components to clear that interference, they may be reused, except where specifically noted to the contrary, providing that their condition is noted by the Owner's representative and they are approved by him as equivalent to new.
- D. Where existing system components are required to be replaced, all new components shall be provided.
- E. System components include all accessories, cables, controls, conduits, hangers, bases and supports and outlets.
- F. The work specified under this contract specifically excludes the removal or patching of "hazardous materials." This includes but is not limited to asbestos, PCBs or any other material having been designated by the Environmental Protection Agency as a hazardous material. If this contractor finds anything, which is suspected of being a hazardous material, it should be immediately brought to the Owner's attention.

3.17 USE OF PREMISES AND CLEANING

- A. Remove and dispose of all waste materials and rubbish due to all construction operations under the contract, except as otherwise noted, and keep the building free from rubbish and dirt caused by his and/or his subcontractors' employees.
 - 1. During the entire progress of the work, rubbish removal shall be made frequently so as to prevent any potential safety or health hazard.
- B. Upon completion of the work, remove all protection, paint, putty, and other stains from all fixtures and glass and leave the premises thoroughly broom cleaned.

3.18 CUTTING, ALTERING AND PATCHING

- A. Provide all cutting, chasing, drilling, altering and rough patching required for the work of this division.
 - 1. Including the restoring of existing work cut for or damaged by installation of new work, and where present work is removed.
 - 2. All materials and workmanship required in connection with cutting, altering and rough patching shall match the existing work in every respect.
- B. Do all shoring, bracing, cutting, patching, piecing out, filling in, repairing and refinishing of all present work as made necessary by the alteration and the installation of new work.

- C. All holes and openings occurring in the existing floors after equipment, partitions, floors, steel work, conduits and pipes are removed or installed shall be closed up with materials similar to the adjacent work.
- D. The size and location of items requiring an opening, chase or other provisions to receive it shall be given by the trade requiring same in ample time to avoid undue cutting of any new work to be installed. These provisions shall not relieve the Contractor from keeping informed as to the required opening, chases, etc., nor from responsibility for the correctness thereof, nor for cutting and repairing after the new work is in place.
- E. Include all cutting, repairing and patching in connection with the work that may be required to make the several parts come together properly and fit it to receive or be received by the work of other trades, as shown on the drawings and/or specified, or reasonably implied by the drawings and specifications.
- F. All repairing, patching, piecing-out, filling-in, restoring and refinishing shall be neatly done by mechanics skilled in their trade to leave same in condition satisfactory to the Owner.
- G. Materials and their methods of application for patching shall comply with applicable requirements of the specifications.
 - 1. Materials and workmanship not covered by the specifications and items of work exposed to view adjoining existing work to remain shall conform to similar materials and workmanship existing in or adjacent to the spaces to be altered.
- H. Cutting, repairing and patching shall include all items shown on the drawings, specified in the specifications or required by the installation of new work or the removal of existing work.
- I. Remove partitions, walls, suspended ceilings, etc., as necessary to perform the required alterations or new construction work.
 - 1. Avoid damage to construction and finishes that are to remain.
- J. Protect and be responsible for the existing building, facilities and improvements.
 - 1. Any disturbance or damage to the work, the existing building, and improvements, or any impairments of facilities resulting from the construction operations, shall be promptly rectified, with the disturbed, damaged, or impaired work, restored, repaired or replaced at no extra cost.
- K. All alterations which are not indicated on the drawings nor specified herein but necessary to make good existing work disturbed by reason of the work shall be restored to a condition satisfactory to the Owner.
- L. All holes in masonry floors and walls are to be core drilled.
- M. Disturbed concrete and /or cement floor areas shall be patched with approved type latex mortar.
 - 1. When cement mortar is used for patching, the surfaces shall be depressed a minimum depth of 1".
- N. Reinstall all weather protection work in waterproof manner.

O. Openings in roofs.

1. Openings in roofs shall be kept properly plugged and caulked at all times, except when being worked on, to preclude the possibility of flooding due to storms or other causes. After completion of work, openings shall be permanently sealed.

P. Temporary openings.

1. All temporary openings cut in walls, floors or ceilings for pipe or ductwork shall be closed off with transite or an equally non-combustible material except when mechanics are actually working at the particular opening.

3.19 TEMPORARY HEAT

A. Provide all labor, fuels, materials, tools, appliances and equipment and perform all operations necessary to maintain sufficient temporary heat to ensure uninterrupted progress in the work and to protect all work and materials against injury from dampness and cold until issuance of the Architect's Final Certificate. The contractor shall assume the cost of the fuel, the cost of other operating supplies used for temporary heating and the costs involved in the operation and maintenance of the temporary wiring and electricity. If the adaptation of the temporary heating system to the contractor's temporary heating needs makes necessary the installation of temporary control valves, gauges, or piping, or the installation of temporary radiation units, the contractor shall bear the costs of such adaptations. In addition to the foregoing, the contractor shall provide temporary heat to the extent itemized below, but not limited to the following:

1. During the placing, setting and curing of all concrete, an ambient temperature of 50° F in the areas involved.
2. During the placing, setting and/or curing of interior masonry, metal furring, plaster, tile; and taping and spackling of drywall an ambient temperature of 60° F shall be maintained in the space involved.
3. In spaces where resilient floor coverings or temperature sensitive material are stored an ambient temperature of 70°F shall be maintained, and such temperature of 70°F shall be maintained, and such temperature shall be maintained 48 hours before, during and 48 hours after installation in each space where such covering is required.
4. Except as noted above, all areas in which work is in progress, shall be maintained at 45°F during working hours.

B. The building will be considered in an enclosed condition when roofing and exterior walls are in place and openings in exterior walls and roof have been provided with temporary or permanent closures.

C. The medium and procedure of providing temporary heat at all times shall be subject to the acceptance of the Owner and Architect.

D. Prior to the building being in an enclosed condition, temporary heat may be provided by approved type of heating and devices complete with covers, vents and/or smoke connections to the outer air so that all human hazards may be eliminated and the surfaces of the buildings protected against damage by deleterious substances resulting from the heating operations.

E. Only heaters employing tanked gas will be permitted. The use of oil or coke as fuels will not be accepted. Provide thermal protection under heating units.

- F. Prior to starting the metal lathing, or drywall spackling, the work shall be sufficiently advanced for the building to be enclosed and for temporary heat to be produced by the permanent heating system.
- G. After the building is enclosed and the permanent heating system or portion of the system is substantially complete and acceptable to the Owner for temporary heating use, the contractor may, at the Owner's discretion, be permitted to use such heating facilities for temporary heat.
- H. The contractor in using the permanent heating system for temporary heating agrees to the following:
 - 1. After the Architect and the Owner approve and accept the project heating system, or portion thereof, for temporary heating purposes, the heating system shall be turned over to the contractor. When the contractor has no further need for temporary heat, the heating system shall be returned to the Owner.
 - 2. The contractor shall assume the cost of the fuel, the cost of other operating supplies used for temporary heating and the costs involved in the operation and maintenance of the temporary wiring and electricity. If the adaptation of the temporary heating system to the contractor's temporary heating needs makes necessary the installation of temporary control valves, gauges, or piping, or the installation of temporary radiation units, the contractor shall bear the costs of such adaptations.
 - 3. That portion of the project's heating system and other related mechanical equipment termed the temporary heating system shall be limited to equipment and the necessary piping, traps, valves, strainers, controls, pumps, starters, wiring and all other apparatus and equipment necessary to cause the temporary heating system to function correctly.
- I. The cost of maintenance of the temporary heating system for temporary heating is the responsibility of the contractor.
- J. The permanent boilers, piping and air handling systems may not be utilized for temporary heating without the operation of the permanent water treatment system and approval from the Building Owner.
- K. These provisions for temporary heating do not alter the requirements of the "General and Supplementary General Conditions" with respect to "Guarantees" and/or any "General Guaranty" contained herein.

3.20 PENETRATIONS THROUGH FIRE SEPARATIONS AND NON-RATED ASSEMBLIES

- A. Pack annular space between duct (insulation), sleeve and pipe (insulation) and / or conduit in fire rated and non-rated construction with fire retardant putty, sealant and / or caulk. Material shall be non-asbestos based and installed in accordance with manufacturers instructions for fire rating required.
- B. Penetrations of multiple items and penetrations with annular space greater than 1/2" shall be provided with a backing material in accordance with manufacturer's instructions and as part of a UL listed assembly.
- C. Fire retardant sealer and system shall meet ASTM E-84, ASTM E-814, and UL-1479.
- D. All fire stopping shall be provided by one (1) manufacturer. Refer to Division 07 and architectural drawings for all requirements.

E.	<u>MANUFACTURER</u>	<u>MODEL</u>
	Dowsil	Firestop 700
	STI	SSP100 Fire Putty
	Nelson	CLK, FSP
	3M	CP-25WB, Fire Putty MP

3.21 SPECIAL WORKMANSHIP REQUIREMENTS FOR ARCHITECTURALLY EXPOSED SYSTEMS

- A. General: In addition to basic project workmanship requirements specified above, a higher degree of care in systems layout and routing shall be exerted in selected areas, as follows:
1. Architectural Exposures: Note that this project includes locations where systems will be partially or fully exposed to view in finished architectural spaces due either to the intentional omission of ceilings, and/or to the intentional holding back of ceiling edges from walls, for architectural effects. These areas shall receive
 2. extra effort and care above and beyond basic project workmanship principles.
- B. Special Workmanship Requirements: In these special areas, comply with the following requirements:
1. Run systems tight to overhead structure whenever possible.
 2. In spaces with gaps between ceiling edges and walls, do not run systems down near ceilings. Locate them as high above as feasible.
 3. Do not cross under framing members within view of such gaps. Seek alternative routes around or through obstacles.
 4. Fasten systems sufficiently often to prevent their visually sagging or drooping between support points.
 5. Route systems parallel to walls, framing members, and other elements defining spatial geometries.
 6. Change directions orthogonally.
 7. Do not run diagonally when traversing horizontal or vertical surfaces.
- C. Rejection of Work: Workmanship and/or materials not complying with the above additional requirements in these special areas to the satisfaction of the Architect shall be rejected and shall be immediately replaced in an acceptable manner without additional cost.

3.22 SHUTDOWN OF EXISTING BUILDING SYSTEMS

- A. Do not interrupt existing services or systems in the building unless absolutely necessary. Such interruptions and interferences must be made as brief as possible and only after coordination with the Owner. The Owner requires a minimum of seven (7) days notice. Obtain prior permission, in writing.
- B. Where the work makes temporary interruptions unavoidable, they shall be made during off hours. "Off hours" shall be dictated by the Owner.
- C. Arrange to work continuously, including overtime, if required, to ensure that systems will shut down only during the time actually required to make the necessary connections to existing work.

3.23 DEMONSTRATION AND TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain all new equipment. Refer to Division 1 Section "Demonstration and Training."
- B. The contractor and subcontractors shall be responsible for coordinating, scheduling and completing operations and maintenance training for the Owners designated personnel on all systems and equipment.
- C. All training materials (agenda, hand-outs, etc.) shall be submitted to the Owner for review and approval at least two weeks in advance of scheduled training.
- D. Equipment training shall be provided by a factory authorized technical representatives, experienced in training, operation and maintenance procedures for installed systems, subsystems and equipment.
- E. All qualifications and certifications of the individual performing the training shall be submitted to the Owner for review and approval at least two weeks in advance of scheduled training.
- F. Each Subcontractor responsible for training will submit a written training plan to the Owner for review and approval at least two weeks in advance of scheduled training. The plan will include field orientation during installation, classroom instruction and field training after the completion of installation.
- G. For all major systems and equipment, the automated temperature controls subcontractor shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others in addition to formal automated temperature controls training on work station operation, graphics, etc.
- H. Provisions shall be included to provide formal classroom training to representatives of the Owner's personnel for select systems and equipment above and beyond typical preventative maintenance training (e.g. manufacturer provided training school, etc.). Coordinate requirements with the owner.
- I. Provisions shall be included to provide professional videotaping of classroom training. For systems not being commissioned, the CM will carry the responsibility of hiring the Cx Videographer. The duration and intensity of the videotaping is to be specified at the discretion of the Owner.
- J. Training Requirements Outline:
 - 1. General familiarization and operating procedures for each of the building's system installations.
 - 2. Routine maintenance procedures for equipment.
 - 3. Specific operating and maintenance procedures for:
 - a. Mechanical systems
 - b. Temperature control system

4. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Schedule for routine cleaning and maintenance.
 - e. Repair instructions.
5. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
6. Quantity of training: The maintenance personnel shall be trained on the various building systems in sessions. The training shall be of a sufficient extent to allow the trained staff, to train their peers and to demonstrate the training sessions were effective. Training time shall be provided based on the systems identified as follows:
 - a. Mechanical systems 8 hrs
 - b. Direct digital control system 8 hrs
7. Video Documentation: The contractor(s) shall provide for the services of a qualified videographer to digitally record the training sessions.

3.0 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.
- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.
- C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the startup procedure.
- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

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.
- B. [Section 019113 – General Commissioning Requirements.](#)

1.02 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Air Control Device Identification
 - 6. Warning tags.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.04 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

- A. Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 5 by 3 inches.
 - 6. Minimum Letter Size: 1 inch for name of units. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws; adhesive for locations where screws or rivets would void warranty of equipment.
- B. Label Content: Include equipment's Drawing designation tag or unique equipment number, equipment description, service, and electrical panel designation serving the equipment. Pump tags shall also indicate gpm, ft of head, and HP for the pump, as indicated on the balance report submittal.
 1. Label Format: EQUIPMENT NUMBER
DESCRIPTION
SERVICE
DATA
ELECTRIC PANEL
 2. Examples:

CWP-5	AHU-1
CHILLED WATER PUMP	VAV AIR HANDLING UNIT
CHILLED BEAMS	FIRST FLOOR EAST
210 GPM / 55 FT / 5 HP	15,000 CFM,
EP-7 / CKT 15,16,17	EP-9 / CKT 21,22,23
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.
- D. Plastic labels shall be plenum rated when located in plenums.
- E. Label material:
 1. Indoors: acrylic or phenolic
 2. Outdoors: phenolic

2.02 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 5 by 3 inch.
- F. Minimum Letter Size: 1 inch for name of units. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws; adhesive for locations where screws or rivets would void warranty of equipment.
- H. Label Content: Include caution and warning information, plus emergency notification instructions.

- I. Plastic labels shall be plenum rated when located in plenums.
- J. Label material:
 - 1. Indoors: acrylic or phenolic
 - 2. Outdoors: phenolic

2.03 PIPE LABELS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Marking Service Inc. MS-478, MS-970 +MS-1000
 - 2. Seton
 - 3. Brimar Industries
- B. General Requirements for Manufactured Pipe Labels: Machine printed, color-coded, with lettering indicating service, pipe size, and showing flow direction. Marker/hand written labels are not acceptable. Not to be utilized on bare pipe with fluid temperatures over 125°F.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners (straps for 6" O.D. of insulation and larger are acceptable) or adhesive. Self-adhesive, sticker type, or pre-coiled polyester with self-sealing lap are not acceptable. Pipe labels and pipe labels adhered to a clear pretensioned sleeve are not acceptable.
- D. Pipe Label Color Schedule: Coordinate with facility standards. If no facility standards exist or are not desired, conform to ASME/ANSI A13.1 - 2023.
- E. Pipe Label Contents: Include identification of piping service, pipe size, and an arrow indicating flow direction.
 - 1. Lettering Size: Conform to ASME/ANSI A13.1 - 2023.
- F. Pipe labels located within plenums only: Self-adhesive, sticker type, rated for plenum use.
 - 1. Pipe Label Contents: Include identification of piping service, pipe size, and an arrow indicating flow direction.
- G. Pipe labels located outdoors shall be provided with a UV protective coating.

2.04 DUCT LABELS

- A. Stencils: Minimum letter height of 2 inches for ducts; and minimum letter height of 1 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Fiberboard or metal.
 - 2. Paint: Exterior, acrylic enamel in colors as indicated.
- B. Label Contents: Include identification of duct service using same designations as used on Drawings, duct size, and an arrow indicating flow direction.

- C. Lettering and arrows color shall meet the facilities standards, if no standard exists, confirm the following color scheme is acceptable prior to commencement of work:
 - 1. Lettering and Arrows:
 - a. Blue: For outside air supply ducts.
 - b. Yellow: For supply air ducts.
 - c. Green: For exhaust, relief, return, and mixed air ducts.
 - d. Red: For hazardous material exhaust.

2.05 AIR CONTROL DEVICE IDENTIFICATION

- A. Identifying Ribbons: Nylon
 - 1. Size: Minimum 1-inch-wide by minimum 12 inches long, free hanging length.
 - 2. Fasteners: Hand tied.
 - 3. Color: Orange or Yellow.
- B. Nylon ribbons shall be plenum rated when located in air plenums.

2.06 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 inches high by 7 inches long.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Red background with white lettering.
- B. Plastic labels shall be plenum rated when located in plenums.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 EQUIPMENT LABEL INSTALLATION

- A. Permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible. Where equipment is located within finished spaces, equipment labels shall not be located on the face of the equipment; where possible, the label shall be located on the least conspicuous side.
- C. All motor driven equipment, HVAC components, and major electrical boxes shall be individually numbered. (Example: For unit heaters, use UH-1, UH-2, etc., even though both units are of the same size and type.) All designations shall be unique, integrated with and distinguished from existing designations.

- D. Air handling unit tags shall have a minimum of 1-inch-high lettering.
- E. The Contractor shall make it possible for the personnel operating and maintaining the equipment and systems in this project to readily identify the various pieces of equipment, valves, piping, etc., by marking them. All items of equipment such as fans, pumps, etc., shall be clearly marked using engraved nameplates as hereinafter specified. The item of equipment shall indicate the same number as shown on the Drawings.

3.03 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units (less than 2' in length)
 - 3. Where flow pattern is not obvious, mark each pipe at branch.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings.
 - 8. Both side of penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 9. At all changes of direction.
 - 10. And at all locations required to conform to ASME/ANSI A13.1 - 2023.
- B. Pipe Label Color Schedule: Coordinate with facility standards. If no facility standards exist or are not desired, conform to ASME/ANSI A13.1 - 2023.
- C. All self-adhesive/sticker type labels located in plenums shall be secured with additional flow arrow tape at each end of the label. Flow arrow tape shall be installed a minimum of 1.5 wraps around the entire circumference of the pipe at each end of the label.

3.04 DUCT LABEL INSTALLATION

- A. Stenciled Duct Label: Stenciled labels, showing service, duct size, and flow direction.
- B. Locate labels/stencils:
 - 1. Near points where ducts enter into concealed spaces.
 - 2. At maximum intervals of 25 feet in each space where ducts are exposed or concealed by removable ceiling system.
 - 3. At all changes of direction.
 - 4. Both sides of penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 5. Near major equipment items and other points of origination and termination.
- C. Labeling/stenciling of all exposed ductwork shall be coordinated with the architect and engineer prior to the commencement.
- D. Stenciling/labeling shall be directly applied to the insulation jacket. Stenciled labels on Foil, FSK, or AJS insulation tape then applied to the insulation jacket is not acceptable.

3.05 AIR CONTROL DEVICE IDENTIFICATION INSTALLATION

- A. Install identifying ribbons on all control devices in duct systems including but not limited to manual volume/balance dampers, splitter dampers, cable operated dampers, automatic control dampers, and barometric dampers when located above accessible and inaccessible ceilings.
- B. Ribbon tied on to control device for the purpose of visibly identifying device locations.
- C. Attach ribbons at the time each control device is installed.
- D. Ribbon shall hang down a minimum of 12" from control device. Ribbons shall not hang below any ceiling.

3.06 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.
- B. Markings shall be provided in locations required by and meeting the color requirements of the "Safety Code Color for Marking Physical Hazards", ANSI Z53.1, latest revision.
- C. Each Machinery and Chiller Room door shall be labeled with the refrigerant(s) present and the health hazard warning labels associated with each.
- D. All emergency break glass (BG) and emergency power off (EPO) switches shall be label with a complete description of their operation and the equipment they serve.
 - 1. Example: CH-1 and CH-2 Emergency Shut Off
This button shuts down chillers CH-1 and CH-2
- E. All refrigerant alarm lights shall be labeled with a complete description of their operation.
 - 1. Example: Refrigerant Warning
DO NOT ENTER
When flashing, high levels of refrigerant are present

3.07 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.
- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.
- C. Operational TestRectify malfunctions, replace defective parts with new one and repeat the startup procedure.
- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

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.
- B. Refer to Specification SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC, PLUMBING, AND ELECTRICAL CONTROLS for balancing values, delay times, differential pressure setpoints, schedules, setpoints, and additional settings.
- C. Section 019113 – General Commissioning Requirements.

1.02 SUMMARY

- A. Balancing contractor shall provide all services required to test, adjust and balance:
 - 1. Each piece of equipment and system indicated on the contract documents, drawings and in the specifications and all air inlets and outlets.
- B. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.

1.03 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 15 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Sample report forms.
- F. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.

2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.05 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC NEBB or TABB.
 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC NEBB or TABB.
 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC NEBB or TABB as a TAB technician.
- B. TAB Conference: Meet with Architect, Construction Manager, and Commissioning Authority (if Commissioning is part of the project) on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide 14 days' advance notice of scheduled meeting time and location.
 1. Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Coordination and cooperation of trades and subcontractors.
 - d. Coordination of documentation and communication flow.
- C. Certify TAB field data reports and perform the following:
 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard TAB contractor's forms approved by Architect.
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing," regardless of conditioned space square footage.

1.06 COORDINATION

- A. Notice: Provide 14 days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- E. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- J. Examine operating safety interlocks and controls on HVAC equipment.
- K. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Automatic temperature-control systems are operational.
 - 3. Equipment and duct access doors are securely closed.
 - 4. Balance, smoke, and fire dampers are open.
 - 5. Isolating and balancing valves are open and control valves are operational.
 - 6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
 1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."
 1. Constant-volume air systems.

3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

- C. Measure air outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns for all the register, grille and diffuser baffles, pattern controllers, and vanes of adjustable outlets to those indicated on the registers, grilles and diffusers shop drawing for proper distribution without drafts.

3.06 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 - 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 - 3. Measure total system airflow. Adjust to within indicated airflow.
 - 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 - 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 - 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
 - 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.

8. Record final fan-performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance variable-air-volume systems the same as described for constant-volume air systems.
 2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
 6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
 8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 3. Set terminal units at full-airflow condition.
 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Adjust terminal units for minimum airflow.
 6. Measure static pressure at the sensor.
 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
- E. Adjust patterns for all the register, grille and diffuser baffles, pattern controllers, and vanes of adjustable outlets to those indicated on the registers, grilles and diffusers shop drawing for proper distribution without drafts.
- F. TABB Contractor shall allow for one sheave replacement for each belt drive fan.

3.07 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.08 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.09 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each electric heating coil:
 - 1. Nameplate data.
 - 2. Airflow.
 - 3. Entering- and leaving-air temperature at full load.
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 - 5. Calculated kilowatt at full load.
 - 6. Fuse or circuit-breaker rating for overload protection.
- B. Measure, adjust, and record the following data for each refrigerant coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Wet-bulb temperature of entering and leaving air.
 - 3. Airflow.
 - 4. Air pressure drop.
 - 5. Refrigerant suction pressure and temperature.

3.10 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 - 3. Check the refrigerant charge.
 - 4. Check the condition of filters.
 - 5. Check the condition of coils.
 - 6. Check the operation of the drain pan and condensate-drain trap.
 - 7. Check bearings and other lubricated parts for proper lubrication.
 - 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
 - 1. New filters are installed.
 - 2. Coils are clean and fins combed.
 - 3. Drain pans are clean.
 - 4. Fans are clean.
 - 5. Bearings and other parts are properly lubricated.
 - 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 - 1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
 - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 - 3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 - 4. Balance each air outlet.

3.11 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Design value to plus 10 percent.
 - 2. Air Outlets and Inlets: Design value to plus 10 percent.
 - 3. Exhaust fans and vav boxes shall be balanced to maintain the design values to plus 10 percent while maintaining a positive pressure relationship with the exterior.

3.12 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.13 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.

- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Fan curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Terminal units.
 5. Balancing stations.
 6. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units, include the following:

1. Unit diagram static pressure profile across all components.
 - a. Schematic diagram of unit and all components.
 - b. Static pressure upstream and downstream of all components indicated on the diagram.
 - c. Include all components, damper, coils, fans, wheels, heat exchangers, humidifier dispersion grids, sound attenuators, baffles.
2. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
3. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
4. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Preheat-coil static-pressure differential in inches wg.
 - g. Cooling-coil static-pressure differential in inches wg.
 - h. Heating-coil static-pressure differential in inches wg.
 - i. Outdoor airflow in cfm.
 - j. Return airflow in cfm.
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:
 - a. System identification.
 - b. Location.

- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.
- g. Face area in sq. ft..
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Refrigerant expansion valve and refrigerant types.
- i. Refrigerant suction pressure in psig.
- j. Refrigerant suction temperature in deg F.
- k. Inlet steam pressure in psig.

G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Fuel type in input data.
- g. Output capacity in Btu/h.
- h. Ignition type.
- i. Burner-control types.
- j. Motor horsepower and rpm.
- k. Motor volts, phase, and hertz.
- l. Motor full-load amperage and service factor.
- m. Sheave make, size in inches, and bore.
- n. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

- a. Total air flow rate in cfm.
- b. Entering-air temperature in deg F.
- c. Leaving-air temperature in deg F.
- d. Air temperature differential in deg F.
- e. Entering-air static pressure in inches wg.
- f. Leaving-air static pressure in inches wg.
- g. Air static-pressure differential in inches wg.
- h. Low-fire fuel input in Btu/h.
- i. High-fire fuel input in Btu/h.
- j. Manifold pressure in psig.

- k. High-temperature-limit setting in deg F.
 - l. Operating set point in Btu/h.
 - m. Motor voltage at each connection.
 - n. Motor amperage for each phase.
 - o. Heating value of fuel in Btu/h.
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
 - 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h.
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Air flow rate in cfm.
 - i. Face area in sq. ft..
 - j. Minimum face velocity in fpm.
 - 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h.
 - b. Air flow rate in cfm.
 - c. Air velocity in fpm.
 - d. Entering-air temperature in deg F.
 - e. Leaving-air temperature in deg F.
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 - 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 1. Report Data:
 - a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft..
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- K. Air-Terminal-Device Reports:
 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Utilize the Register, grille, and diffuser layout floor plans submittal, refer to Specification 233713 Register, Grille, and Diffusers.
 - c. Schedule: Indicate drawing designation, room location, size, unique number identifier, and accessories furnished. Unique number identifier shall match the RGD submittal.
 - d. Indicate air patterns for all air terminal devices.
 - e. Apparatus used for test.
 - f. Area served.
 - g. Make.
 - h. Type and model number.
 - i. Effective area in sq. ft..
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.

L. Instrument Calibration Reports:

1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.14 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
 - a. Measure airflow of 100 percent of air outlets.
 - b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - c. Verify that balancing devices are marked with final balance position.
 - d. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.15 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

3.16 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.
- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.
- C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the startup procedure.
- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

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. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Fastener systems.
 - 5. Equipment supports.
 - 6. Plastic Pipe Supports.
 - 7. Thermal-hanger shield inserts
 - 8. Insulation clamps
- B. Related Sections:
 - 1. Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
 - 2. [Section 019113 – General Commissioning Requirements.](#)

1.03 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.04 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design shop and field fabricated trapeze pipe hangers and shop and field fabricated equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following: include Product Data for shop and field fabricated components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Pipe stands.
 - 4. Equipment supports.
- C. Delegated-Design Submittal: For shop and field fabricated trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Detail fabrication and assembly of shop and field fabricated trapeze hangers.
 - 2. Design Calculations: Calculate requirements for designing shop and field fabricated trapeze hangers.

1.06 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.07 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with these specifications, metal pipe hanger and support systems shall be one of the following or engineer-approved equal.
 - 1. Anvil International
 - 2. ERICO, Inc.
 - 3. PHD
 - 4. Hubbard Enterprises

2.02 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS-SP-58, factory-fabricated components, for Types indicated in PART 3 EXECUTION.
 - 2. Metallic Coatings:
 - a. Corrosive/Moist/Exterior environments: Hot dipped galvanized.
 - b. General Service: Electrogalvanized.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.

4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. MSS SP-58 Continuous-thread hanger rod, nuts, and washers:
 - a. Corrosive/Moist/Exterior environments: Carbon-Steel Hot dipped galvanized.
 - b. General Service: Carbon-Steel Electro galvanized.

2.03 TRAPEZE PIPE HANGERS

- A. Description: MSS-SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes.
- B. Metallic Coatings:
 1. Corrosive/Moist/Exterior environments: Hot dipped galvanized.
 2. General Service: Electro galvanized.
- C. MSS SP-58 Continuous-thread hanger rod, nuts, washers, and U-bolts:
 1. Corrosive/Moist/Exterior environments: Carbon-Steel Hot dipped galvanized.
 2. General Service: Carbon-Steel Electro galvanized.

2.04 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.
 2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
 3. Standard: MFMA-4.
 4. Channels: Continuous slotted steel channel with inturred lips.
 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of:
 - a. Hostile/Corrosive/Moist/Exterior environments: Carbon-Steel.
 - b. General Service: Carbon-Steel.
 7. Metallic Coatings:
 - a. Corrosive/Moist/Exterior environments: Hot dipped galvanized.
 - b. General Service: Electro galvanized.

8. All hanger rod and channel ends; exposed and less than or equal to 12 ft above finished floor; shall be provided with plastic caps and plastic channel safety end caps.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International; a subsidiary of Mueller Water Products Inc.
 - b. Empire Industries, Inc.
 - c. ERICO International Corporation.
 - d. Haydon Corporation; H-Strut Division.
 - e. NIBCO INC.
 - f. PHD Manufacturing, Inc.
 - g. PHS Industries, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturred lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of:
 - a. Corrosive/Moist/Exterior environments: Carbon-Steel.
 - b. General Service: Carbon-Steel.
7. Metallic Coatings:
 - a. Corrosive/Moist/Exterior environments: Hot dipped galvanized.
 - b. General Service: Electrogalvanized.
8. All hanger rod and channel ends; exposed and less than or equal to 12 ft above finished floor; shall be provided with plastic caps and plastic channel safety end caps.

2.05 THERMAL-HANGER SHIELD INSERTS

- A. Products: 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. Buckaroos, Inc.
 2. Zsi-Foster HWP/HWT
- B. 3.75 PCF phenolic foam or calcium silicate pipe insulation shall have a maximum K factor of 0.16 Btu-in/hr-ft²°F at a mean temperature of 75°F.
- C. For cold applications below 75°F, a zero perm rated (ASTM E96), abuse resistant vapor retarder jacket with an 1 ½" wide acrylic longitudinal self-seal tape shall be installed. Matching zero perm Butt Strips will be provided for a complete sealed system. Insulation and zero perm jacketing shall extend 1 ½" beyond the Saddle to allow for sealing the butt joints to be sealed with a 3" wide zero perm.
- D. ASTM E84 0 FSI, 50 SDI

- E. For Trapeze or Clamped Systems: Shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Shield shall cover lower 180 degrees of pipe.

2.06 INSULATION CLAMPS

- A. Products: 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. | Zsi-Foster | Cush-A-Therm |
| 2. | Aeroflex | Aerofix |
- B. Insulation shall be continuous through support.
- C. ASTM E84 0 FSI, 50 SDI
- D. Water vapor permeability: 0 (ASTM E96)

2.07 FASTENER SYSTEMS

- A. Mechanical-Wedge Anchors: Wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers:
- | | | |
|----|---|------------------|
| a. | Powers Fasteners. | Model Power-Stud |
| b. | B-Line Systems, Inc.; a division of Cooper Industries | Model AWA |
| c. | Hilti, Inc. | Model KB |
| d. | ITW Ramset/Red Head. | Model Trubolt |
| e. | MKT Fastening, LLC. | Model Sup-R-Stud |
- B. Mechanical Anchor: Steel threaded fastening system for suspending threaded rod vertically overhead; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers:
- | | | |
|----|---|--|
| a. | Powers Fasteners. | Model Vertigo; Wood Vertical Hanger and Wood Side Hanger |
| b. | B-Line Systems, Inc.; a division of Cooper Industries | Model ARS, ARSW |
| c. | Simpson Strong-Tie | Model RWV, RWH |
- C. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.08 EQUIPMENT SUPPORTS

- A. Refer to Specification 230548 for exterior equipment curbs and rails.

- B. Indoor equipment supports:
 - 1. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.
- C. Metallic Coatings:
 - 1. Corrosive/Moist/Exterior environments: Hot dipped galvanized.
 - 2. General Service: Electrogalvanized.

2.09 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars
- B. Metallic Coatings:
 - 1. Corrosive/Moist/Exterior environments: Hot dipped galvanized.
 - 2. General Service: Electrogalvanized.
- C. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

2.10 PLASTIC PIPE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armacell Insuguard with InsuCover
 - 2. Eaton B-Line Snap 'N Shield.
- B. UL classified for USA.
- C. UV Resistant.
- D. ASTM E84 certified.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS-SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS-SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

-
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
 - D. All hanger rod and channel ends; exposed and less than or equal to 12ft above finished floor; shall be provided with plastic caps and plastic channel safety end caps.
 - E. Thermal-Hanger Shield Installation: Install in all pipe hangers and shields for insulated piping.
 - F. Fastener System Installation:
 - 1. Powder-actuated fasteners are not acceptable.
 - 2. When possible, install concrete inserts before placing concrete.
 - 3. Install mechanical-wedge type anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
 - 4. Pin/nail anchors, spikes, expansion shields, expansion anchors, dropin anchors, wedge bolts, self-tapping screws, screw anchors, and friction clamps are not acceptable.
 - G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
 - H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
 - I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
 - J. Install lateral bracing with pipe hangers and supports to prevent swaying.
 - K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
 - L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
 - M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
 - N. Insulated Piping:
 - 1. Install insulated clamps.
 - 2. Attach clamps and spacers to piping. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 3. Install MSS SP-58, Type 39, protection saddles. Fill interior voids with insulation that matches adjoining insulation.
 - 4. Install MSS SP-58, Type 40, protective shields. Shields shall span an arc of 180 degrees.
 - a. Thermal-hanger shield inserts shall be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

5. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 6. Insert Material: Length at a minimum of 2" longer; in each direction; than protective shield length.
- O. All pipe hangers shall be sized to accommodate the pipe, pipe insulation thickness and protective shields and saddles. Insulation shall be continuous through all hangers and penetrations.
1. Insulation may not be continuous through the hanger when riser clamps and pipe clamps are utilized for vertical support. Insulation shall be continuous around the pipe clamp and continue 3" on the method of support; threaded rod, pipe stand.
 2. Insulation shall be continuous through the hanger when pipe clamps are utilized for horizontal suspension. Full circumference protective shield shall be utilized.

3.02 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.
- C. Provide plastic caps on the ends of all threaded rod exposed and less than or equal to 12ft above finished floor.

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 a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099600 "High Performance Coatings."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS-SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel electrogalvanized pipe hangers and supports, electrogalvanized metal trapeze pipe hangers and electrogalvanized metal framing systems and attachments for general service applications.
- F. Use carbon-steel hot dipped galvanized pipe hangers and supports, hot dipped galvanized metal trapeze pipe hangers and hot dipped galvanized metal framing systems and attachments for corrosive/moist/exterior service applications.
- G. Use padded hangers for piping that is subject to scratching.
- H. Use thermal-hanger shield inserts for insulated piping and tubing.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.

3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 4. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated and insulated, stationary pipes NPS 1/2 to NPS 2.
 5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For floor mounting of insulated, stationary pipes below 100°F NPS 3/8 to NPS 3.
 6. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 7. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 2-1/2 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 9. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
 10. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 11. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Wedge type mechanical expansion anchor: For upper attachment to suspend hangers from concrete.
 2. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete.
 3. Top-Beam (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape. Retaining strap/clip required.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 8. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 9. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 10. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

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11. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 12. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 13. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 14. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length indicated in above sections.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- N. Comply with MSS-SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
1. Each pipe shall be provided with a U-bolt to retain the pipe on the hanger.
 2. Each insulated pipe shall be provided with a 360 degree insulation shield at each U-bolt.

- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Only refrigerant piping may be supported using plastic pipe supports.
- Q. Use mechanical-wedge type anchors in concrete after concrete is placed and completely cured instead of building attachments where required in concrete construction.
 - 1. Powder-actuated fasteners are not acceptable.
 - 2. When possible, install concrete inserts before placing concrete.
 - 3. Install mechanical-wedge type anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
 - 4. Pin/nail anchors, spikes, expansion shields, expansion anchors, dropin anchors, wedge bolts, self tapping screws, screw anchors, and friction clamps are not acceptable.

3.07 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.
- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.
- C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the startup procedure.
- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

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.
- B. [Section 019113 – General Commissioning Requirements.](#)

1.02 SUMMARY

- A. Section Includes:
 - 1. Backdraft and pressure relief dampers.
 - 2. Manual volume dampers.
 - 3. Fire dampers.
 - 4. Ceiling radiation dampers.
 - 5. Smoke dampers.
 - 6. Combination fire and smoke dampers.
 - 7. Corridor dampers.
 - 8. Flange connectors.
 - 9. Turning vanes.
 - 10. Remote damper operators.
 - 11. Duct-mounted access doors.
 - 12. Flexible connectors.
 - 13. Flexible ducts.
 - 14. Duct accessory hardware.
- B. Related Requirements:
 - 1. Section 283111 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For duct silencers; include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control-damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.

- e. Wiring Diagrams: For power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.06 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" latest edition 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.
- C. Comply with Rhode Island Mechanical Code.

2.02 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" latest edition for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.

- 2. Finishes for Surfaces Exposed to View: G60
- 3. Finished for surfaces indicated to be field painted: galvanized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Material shall match components, minimum 3/8-inch.

2.03 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - 3. Pottorff.
 - 4. Ruskin Company.
- B. Description: Gravity balanced.
- C. Frame: Hat-shaped, 0.063-inch- thick extruded aluminum, with welded corners or mechanically attached and mounting flange.
- D. Blades: Multiple single-piece blades, maximum 6-inch width, 0.050-inch- thick aluminum sheet with sealed edges.
- E. Blade Action: Parallel.
- F. Blade Seals: Neoprene, mechanically locked.
- G. Blade Axles:
 - 1. Material: Aluminum.
 - 2. Diameter: 0.20 inch.
- H. Tie Bars and Brackets: Aluminum.
- I. Return Spring: Adjustable tension.
- J. Bearings: Steel ball or synthetic pivot bushings.
- K. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Chain pulls.

- 4. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20 gage minimum.
 - b. Sleeve Length: 6 inches minimum.
- 5. Screen Material: Aluminum.
- 6. Screen Type: Insect.
- 7. 90-degree stops.

2.04 MANUAL VOLUME DAMPERS

- A. Single Blade Dampers. Maximum width of single blade shall be 14", use opposed blade damper for height exceeding 14". Pre-manufactured dampers shall be part of an assembly complete with damper, frame, axle and bearings. The damper frame shall be installed internal to the duct and fastened with the appropriate hardware. The installation shall not interfere with the operation of the damper blade(s). Approved products shall be pre-manufactured devices.
- B. Multiple Blade Dampers. Opposed blade damper shall be used where duct height exceeds 14". Approved products shall be pre-manufactured devices.
- C. Steel, Manual Volume Dampers: Except for outdoor air, shower exhaust, toilet exhaust
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Rectangular	Air Balance	AC-111
	Greenheck	MBD-10
	Ruskin	MD25
Round	Air Balance	AC-112
	Greenheck	MBDR50
	Ruskin	MDRS25, CDRS15
Opposed Blade	Air Balance	AC-2
	Greenheck	MBD-15
	Ruskin	MD35OB
 - 2. Linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat shaped.
 - b. Galvanized-steel channels, 0.064 inch thick.
 - c. Mitered and welded corners.
 - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Parallel- or opposed-blade design.
 - b. Stiffen damper blades for stability.
 - c. Galvanized, roll-formed steel, 0.064 inch thick.
 - 6. Blade Axles: Galvanized steel.
 - 7. Bearings:
 - a. Provide zero leak open end bearing and closed end bearing on the operating shaft.
 - 1) Zero leak bearings shall be by DuroDyne model SB, Ventlok 607/609, or Elgen.

- b. Dampers in ducts shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Jamb Seals: Cambered aluminum.
 - 9. Tie Bars and Brackets: Aluminum.
 - 10. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
 - 1) Locking quadrants shall be equivalent to Rossi Megalock, Windgate SURE-LOC HD, Durodyne Dyna-Click with cast metal handle.
 - b. Include standoffs for insulated ductwork.
- D. Aluminum, Manual Volume Dampers: For outdoor air, shower exhaust, toilet exhaust
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McGill AirFlow LLC.
 - b. Pottorff; a division of PCI Industries, Inc.
 - c. Ruskin Company. CD51, CD35
 - 2. Linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Parallel- or opposed-blade design.
 - b. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 - c. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
 - 6. Blade Axles: Galvanized steel.
 - 7. Bearings:
 - a. Provide zero leak open end bearing and closed end bearing on the operating shaft.
 - 1) Zero leak bearings shall be by DuroDyne model SB, Ventlok 607/609, or Elgen.
 - b. Dampers in ducts shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Jamb Seals: Cambered aluminum.
 - 9. Tie Bars and Brackets: Aluminum.
 - 10. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
 - 1) Locking quadrants shall be equivalent to Rossi Megalock, Windgate SURE-LOC HD, Durodyne Dyna-Click with cast metal handle.
 - b. Include standoffs for insulated ductwork.

- E. Jackshaft:
 - 1. Size: 1-inch diameter.
 - 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 - 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- F. All dampers shall be furnished with an elevated platform/standoff for insulated duct mounting.
- G. Provide dampers in all branch ducts and duct splits whether indicated or not on the drawings.

2.05 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - 3. Ruskin Company DIBDX, IBDT, DIBDXGA
- B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.060-inch thick and of length to suit application. Sleeve thickness shall not be less than the gauge of the connecting duct.
 - 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as necessary for proper installation.
- H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165°F rated, fusible links.
- K. Grille Access Fire Dampers shall be provided where sidewall grilles are mounted to a fire rated wall.
- L. Provide dampers; as required by all local and state codes; in ducts whether indicated or not on the drawings.

2.06 CEILING DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ruskin Company
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
- B. General Requirements:
 - 1. Labeled according to UL 555C by an NRTL.
 - 2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."
- C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.
- D. Blades: Galvanized sheet steel with refractory insulation.
- E. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
- F. Fire Rating: 2 or 3 hours as required to maintain fire rating.

2.07 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - 3. Ruskin Company. Model SD60
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- D. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- E. Leakage: Class I.
- F. Rated pressure and velocity to exceed design airflow conditions.
- G. Mounting Sleeve: Factory-installed, 0.060-inch thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking. Sleeve thickness shall not be less than the gauge of the connecting duct.
- H. Damper Motors: Modulating or two-position action as indicated in operational sequences.

- I. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC."
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.
 - 8. All actuators shall be furnished with normally open (NO) and normally closed (NC) contacts.
- J. Grille Access Smoke dampers shall be provided where sidewall grilles are mounted to a smoke rated wall.
- K. Accessories:
 - 1. Auxiliary end switches for signaling.
- L. Provide dampers; as required by all local and state codes; in ducts whether indicated or not on the drawings.

2.08 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation. FSD3 w/ TOR
 - 2. Nailor Industries Inc.
 - 3. Ruskin Company. FSD60 w/ TS-150, FSD60FA w/TS-150
 - 4. Air Balance Inc. FA1 w/ Sens-O-Therm
- B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 hours and 3 hours.
- E. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

- G. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- H. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- I. Leakage: Class I.
- J. Rated pressure and velocity to exceed design airflow conditions.
- K. Mounting Sleeve: Factory-installed, 0.060-inch- thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking. Sleeve thickness shall not be less than the gauge of the connecting duct.
- L. Damper Motors: Modulating or two-position action as indicated in operational sequences.
- M. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section "Instrumentation and Control for HVAC" and Division 26 Sections.
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.
 - 8. All actuators shall be furnished with normally open (NO) and normally closed (NC) contacts.
- N. Grille Access Fire/Smoke dampers shall be provided where sidewall grilles are mounted to a smoke rated wall.
- O. Accessories:
 - 1. Auxiliary end switches for signaling.
- P. Provide dampers; as required by all local and state codes; in ducts whether indicated or not on the drawings.

2.09 CORRIDOR DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ruskin Company
 - 2. Greenheck Fan Corporation.
 - 3. Nailor Industries Inc.
- B. General Requirements: Label combination fire and smoke dampers according to UL 555 for 1-1/2-hour rating by an NRTL.
- C. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
- D. Frame: Multiple-blade type; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- F. Mounting Sleeve: Factory-installed, 0.060-inch- thick, galvanized sheet steel; length to suit wall or floor application. Sleeve thickness shall not be less than the gauge of the connecting duct.

2.10 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Nexus PDQ; Division of Shilco Holdings Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.11 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufacturers Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows" unless otherwise noted.

- D. Vane Construction: Turning vanes shall be double wall construction of minimum 24 gauge galvanized metal for 4 1/2" radius vanes and minimum 26 gauge galvanized metal for 2" radius vanes. Each vane shall be securely riveted or welded to minimum 22 gauge runner or directly to duct.
- E. Turning vanes shall have 2" inside radius spaced 2-1/8" apart through 24" wide duct. Vanes in elbows larger than 24" shall have a 4 1/2" radius and be spaced 3 1/4" apart.
- F. Vanes shall be installed in sections to reduce unsupported length for ducts exceeding 60" in height.

2.12 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Metropolitan Air model RT-WGA
 - 2. Young Regulator
 - 3. DuroDyne
- B. Description: Worm and spur gear driven, rotary actuation cable system designed for remote manual damper adjustment.
- C. Cable: Steel.
- D. Cable operated dampers (COD) shall be provided where indicated on plans, and/or where required due to damper location above/behind finished construction, where access to damper would require access door in finished construction.
- E. Provide cable operated dampers in branch duct serving diffusers in inaccessible ceiling locations whether indicated or not on the drawings.
- F. Cable shall terminate within the face of each diffuser/register/grille. Damper shall be adjustable through the face of the diffuser/register/grille with standard Philips head tool. Provide thin-blade screwdriver adjustable cable tip.
- G. Furnish all required duct penetration seal plates, gaskets, bearings, retainers, and cable to duct mounting clamps.
- H. Cable lengths shall be coordinated to allow damper to be placed at the branch duct take-off immediately off the main. Dampers shall be located as far as possible from the terminal outlet/diffuser.
- I. Damper shall be by the manufacturer specified in the Manual Volume Dampers section of this specification. Bowtie and radial blade dampers are not acceptable.

2.13 DUCT AND PLENUM MOUNTED ACCESS DOORS (0.5-2.0 in w.g.)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acudor
 - 2. KEES Incorporated
 - 3. Ruskin

4. Ventfabrics Incorporated
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct" unless otherwise noted.
 1. Door:
 - a. Double wall, rectangular.
 - b. Door material shall match the duct/plenum material it is installed in.
 - c. Door shall be double wall with insulation fill.
 - d. Insulation thickness shall meet the insulation thickness of the duct/plenum the access door is installed in. Provide 2" thick insulation double wall access door unless otherwise noted.
 - e. Latches: equivalent to Ventfabrics, Inc. No. 100 for small doors and No. 310 where physical access is possible. Window latch/sash type hardware is specifically prohibited. Use multiple latches (minimum 4) where the door swing for a hinged door is restricted by the hung ceiling or some other obstruction.
 - f. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors less than 12 inches: Two hinges and one latch.
 - b. Access Doors 12 inches up to 20 Inches: Two hinges and two latches.
 - c. Access Doors 22 inches up to 24 Inches: Three hinges and two latches with outside and inside handles.
 - d. Access Doors larger than 24 Inches: Three hinges and two latches with outside and inside handles.
 4. Access doors shall be rated to maintain the fire/smoke rating of the equipment/duct in which they are installed.

2.14 DUCT AND PLENUM MOUNTED ACCESS DOORS (4.0-10 in w.g.)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Nailor
 2. Arrow
 3. Air Balance
 4. KEES Incorporated
- B. Duct and Plenum Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct" unless otherwise noted.
 1. Door:
 - a. Double wall, rectangular.
 - b. Door material shall match the duct/plenum material it is installed in.
 - c. Door shall be double wall with insulation fill.
 - d. Insulation thickness shall meet the insulation thickness of the duct/plenum the access door is installed in. Provide 2" thick insulation double wall access door unless otherwise noted.

- e. Latches: equivalent to Ventfabrics, Inc. No. 100 for small doors and No. 310 where physical access is possible. Window latch/sash type hardware is specifically prohibited. Use multiple latches (minimum 4) where the door swing for a hinged door is restricted by the hung ceiling or some other obstruction.
 - f. Fabricate doors airtight and suitable for duct pressure class.
- 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less up to 12 Inches: Two hinges and three latches.
 - b. Access Doors up to 20 Inches: Three hinges and four latches.
 - c. Access Doors up to 24 Inches: Three hinges and six latches with outside and inside handles.
 - d. Access Doors Larger than 24 Inches: Four hinges and six latches with outside and inside handles.
 - 4. Access doors shall be rated to maintain the fire/smoke rating of the equipment/duct in which they are installed.

2.15 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Ventfabrics, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 480 lbf/inch in the wrap and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd..
 - 2. Tensile Strength: 530 lbf/inch in the wrap and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.
- G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
 - 1. Minimum Weight: 16 oz./sq. yd..
 - 2. Tensile Strength: 285 lbf/inch in the wrap and 185 lbf/inch in the filling.
 - 3. Service Temperature: Minus 67 to plus 500 deg F.

2.16 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- | | | |
|----|-------------------------|---------|
| 1. | Flexmaster U.S.A., Inc. | Type 3M |
| 2. | H&C Flex | F296 |
| 3. | Buckley | Type 3M |
| 4. | Thermaflex | M-KC |
- B. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum/metalized/polyester core supported by helically wound, spring-steel wire; formaldehyde-free fibrous-glass insulation; aluminized/metalized polyester jacket and vapor-barrier film.
1. Pressure Rating: 10-inch wg positive and 5.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 20 to plus 210 deg F.
 4. Flame/Smoke Spread: 25/50.
 5. R-value=6.0 minimum unless otherwise noted.
- C. Flexible Duct Connectors:
1. Clamps: Stainless steel strap in sizes 3 through 18 inches, to suit duct size.

2.17 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ventlok #699
 - b. DuroDyne IP-2, IP4
 - c. Or approved equal
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install motorized dampers at the discharge of exhaust fans or exhaust ducts as close as possible to the exhaust outlet unless otherwise indicated.

- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts whether indicated or not. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel. Install damper in acoustically lined ducts in such a manner to avoid damage to liner and to avoid erosion of duct liner.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Provide volume dampers in each branch duct serving all inlets and outlets whether indicated or not.
- G. Install volume damper as close to main as possible, maximum 2 duct widths from branch takeoff.
- H. Install ribbon tag tied on to air control device for the purpose of visibly identifying control device locations.
- I. Install test holes at fan inlets and outlets and elsewhere as indicated and as required.
- J. Install fire, fire /smoke and smoke dampers according to UL listing.
- K. Connect ducts to duct silencers rigidly.
- L. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 7. At each change in direction and at maximum 50-foot (15-m) spacing.
 - 8. Upstream and downstream from turning vanes.
 - 9. Upstream or downstream from duct silencers.
 - 10. Control devices requiring inspection.
 - 11. Elsewhere as indicated.
- M. Install access doors with swing against duct static pressure.
- N. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 12 by 12 inches.
 - 2. Two-Hand Access: 12 by 12 inches.
 - 3. Head and Hand Access: 20 by 16 inches.
 - 4. Head and Shoulders Access: 24 by 24 inches.

- 5. Body Access: 24 by 24 inches.
- 6. Body plus Ladder Access: 24 by 24 inches.

- O. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

- P. Locate all duct balancing dampers above accessible ceilings, or provide cable operated dampers.

- Q. Install flexible connectors to connect ducts to equipment.

- R. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

- S. Install duct test holes where required for testing and balancing purposes.

3.02 FLEXIBLE DUCT

- A. Flexible duct sections shall not exceed 4'-0" fully extended.
- B. Flexible ductwork shall not be used for offsets or elbows.
- C. Joints shall be made with a minimum 2" overlap lined with mastic and sealed with metal clamps.
 - 1. Products: 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. 3M Scotch Seal EC800 mastic
 - b. Ductmate – 5511M Sealant
 - c. RCD - #7 Mastic
- D. Flexible ductwork shall only be used for branch duct to diffuser connections when indicated as an acceptable connector on the mechanical drawing details.
- E. Connections from branch duct to diffuser necks shall be rigid sheet metal unless otherwise noted on the drawing details.
- F. Flexible ductwork shall be supported in accordance with SMACNA Figure 3-10 and 3-11 "Flexible Duct Supports". A minimum of two (2) 1" wide metal straps shall be used. Wire hanging is not acceptable.

3.03 TEST CONNECTIONS

- A. On the discharge duct from each air handling unit downstream at least 5'-0" from unit if duct is accessible, or closer to unit if necessary, install a #699 Ventlock instrument test hold device for balancing and testing of system.

3.04 ACCESS DOORS IN WALLS AND CEILINGS

- A. Furnish access doors complying with the specified requirements in Access Doors and Panels.
- B. At each control and balancing damper in ductwork, at each fire damper and volume box, when located above ceiling or inside the wall not accessible by removal of grille or from the airshafts,

furnish an access door for installation by the general contractor. Access doors shall be 18" x 18"(minimum) unless otherwise indicated on plans. In plenum ceilings, provide felt between the door and frame to make an airtight seal.

- C. All access panel locations shall be shown on the Coordination Drawings.
- D. Access doors shall be rated to maintain the fire/smoke rating of the wall/ceiling/construction in which they are installed.

3.05 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.
 - 5. Operate remote damper operators to verify full range of movement of operator and damper.

3.06 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.
- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.
- C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the startup procedure.
- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

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.
- B. [Section 019113 – General Commissioning Requirements.](#)

1.02 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
 - 1. Thermostatic expansion valves.
 - 2. Solenoid valves.
 - 3. Hot-gas bypass valves.
 - 4. Filter dryers.
 - 5. Strainers.
 - 6. Pressure-regulating valves.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Shop Drawing Scale: 1/4 inch equals 1 foot.
 - 2. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.04 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control test reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.07 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.08 COORDINATION

- A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

PART 2 - PRODUCTS

2.01 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 280, Type ACR.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig.
 - 5. Maximum Operating Temperature: 250 deg F.

2.02 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; Type, Grade, and wall thickness as selected in Part 3 piping applications articles.
- B. Wrought-Steel Fittings: ASTM A 234/A 234M, for welded joints.
- C. Steel Flanges and Flanged Fittings: ASME B16.5, steel, including bolts, nuts, and gaskets, bevel-welded end connection, and raised face.
- D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Flanged Unions:
 - 1. Body: Forged-steel flanges for NPS 1 to NPS 1-1/2 and ductile iron for NPS 2 to NPS 3. Apply rust-resistant finish at factory.
 - 2. Gasket: Fiber asbestos free.
 - 3. Fasteners: Four plated-steel bolts, with silicon bronze nuts. Apply rust-resistant finish at factory.
 - 4. End Connections: Brass tailpiece adapters for solder-end connections to copper tubing.
 - 5. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
 - 6. Pressure Rating: Factory test at minimum 400 psig.

7. Maximum Operating Temperature: 330 deg F.

F. Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, stainless-steel-wire-reinforced protective jacket
2. End Connections:
 - a. NPS 2 and Smaller: With threaded-end connections.
 - b. NPS 2-1/2 and Larger: With flanged-end connections.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.03 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.

3. Seat: Polytetrafluoroethylene.
 4. End Connections: Copper spring.
 5. Working Pressure Rating: 500 psig.
- E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
1. Body and Bonnet: Plated steel.
 2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
 6. Working Pressure Rating: 400 psig.
 7. Maximum Operating Temperature: 240 deg F.
 8. Manual operator.
- F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 2. Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Seat Disc: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Working Pressure Rating: 400 psig.
 6. Maximum Operating Temperature: 240 deg F.
- G. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 5. Superheat: Adjustable.
 6. Reverse-flow option (for heat-pump applications).
 7. End Connections: Socket, flare, or threaded union.
 8. Working Pressure Rating: 700 psig.
- H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 5. Seat: Polytetrafluoroethylene.
 6. Equalizer
 7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
 8. End Connections: Socket.
 9. Throttling Range: Maximum 5 psig.
 10. Working Pressure Rating: 500 psig.
 11. Maximum Operating Temperature: 240 deg F.
- I. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
 2. Screen: 100-mesh stainless steel.

3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

J. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

K. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

L. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Designed for reverse flow (for heat-pump applications).
4. End Connections: Socket.
5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
6. Maximum Pressure Loss: 2 psig.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

M. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Designed for reverse flow (for heat-pump applications).
4. End Connections: Socket.
5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
6. Maximum Pressure Loss: 2 psig.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

N. Mufflers:

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or flare.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

- O. Receivers: Comply with ARI 495.
 - 1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
 - 2. Comply with UL 207; listed and labeled by an NRTL.
 - 3. Body: Welded steel with corrosion-resistant coating.
 - 4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
 - 5. End Connections: Socket or threaded.
 - 6. Working Pressure Rating: 500 psig.
 - 7. Maximum Operating Temperature: 275 deg F.
- P. Liquid Accumulators: Comply with ARI 495.
 - 1. Body: Welded steel with corrosion-resistant coating.
 - 2. End Connections: Socket or threaded.
 - 3. Working Pressure Rating: 500 psig.
 - 4. Maximum Operating Temperature: 275 deg F.

2.04 REFRIGERANTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Atofina Chemicals, Inc.
 - 2. DuPont Company; Fluorochemicals Div.
 - 3. Honeywell, Inc.; Genetron Refrigerants.
 - 4. INEOS Fluor Americas LLC.
- B. ASHRAE 34, R-134a: Tetrafluoroethane.
- C. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.
- D. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS FOR REFRIGERANT

- A. Refer to schedule on drawings.

3.02 VALVE AND SPECIALTY APPLICATIONS

- A. Install diaphragm packless valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- E. Install a full-sized, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 - 1. Install valve so diaphragm case is warmer than bulb.
 - 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 - 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 - 1. Solenoid valves.
 - 2. Thermostatic expansion valves.
 - 3. Hot-gas bypass valves.
 - 4. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- L. Install receivers sized to accommodate pump-down charge.
- M. Install flexible connectors at compressors.

3.03 PIPING INSTALLATION

- A. Install piping as indicated on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence of Operations for HVAC Controls" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
 - 1. Shot blast the interior of piping.
 - 2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
 - 3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
 - 4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
 - 5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
 - 6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.
- R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- S. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- T. 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."
- U. 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."

3.04 PIPE 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 pipe and fittings before assembly.
- C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

- D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- F. Threaded Joints: Thread steel pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.
- H. Welded Joints: Construct joints according to AWS D10.12/D10.12M.
- I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.05 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 3/8 inch.
 - 2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 3/8 inch.
 - 3. NPS 1: Maximum span, 72 inches; minimum rod size, 3/8 inch.
 - 4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
 - 7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
 - 8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 9. NPS 4: Maximum span, 12 feet; minimum rod size, 3/8 inch.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 2. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 - 3. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 - 4. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.

- E. Support multifloor vertical runs at least at each floor.

3.06 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Refrigerant piping systems that are erected in the field shall be pressure tested for strength and leak tested for tightness after installation, before insulating, and before being placed into operation. Tests shall include both the high- and low-pressure sides of each system.
 - 2. Refrigerant pipe and joints installed in the field shall be exposed for visual inspection and testing prior to being covered or enclosed.
 - 3. The medium used for pressure testing the refrigerant system shall be one of the following inert gases: oxygen-free nitrogen, helium or argon. Oxygen, air, combustible gases and mixtures containing such gases shall not be used as a test medium.
 - 4. The means used to pressurize the refrigerant piping system shall have on its outlet side a test pressure measuring device and either a pressure-limiting device or a pressure-reducing device. The test pressure measuring device shall have an accuracy of +/- 3 percent or less of the test pressure and shall have a resolution of 5 percent or less of the test pressure.
 - 5. The refrigerant piping system shall be tested as a whole, or separate tests shall be conducted for the low-pressure side and high-pressure side of the piping system. The refrigerant piping system shall be tested in accordance with both of the following methods:
 - a. The system shall be pressurized for a period of not less than 60 minutes to not less than the lower of the design pressures or the setting of the pressure relief device(s). The design pressures for testing shall be the pressure listed on the label nameplate of the condensing unit, compressor, compressor unit, pressure vessel, or other system component with a nameplate. Additional test gas shall not be added to the system after the start of the pressure test. The system shall not show loss of pressure on the test pressure measuring device during the pressure test. Where using refrigerant as a test medium in accordance with paragraph 3 above, the test pressure shall be not less than the saturation dew point pressure at 77°F
 - b. A vacuum of 50 microns shall be achieved. After achieving a vacuum, the system shall be isolated from the vacuum pump. The system pressure shall not rise above 1,500 microns for a period of not less than 10 minutes.
 - 6. Where testing systems using centrifugal or other nonpositive displacement compressors, the entire system shall be considered to be the low-pressure side for test purposes.
 - 7. Testing shall be witnessed by the construction manager, commissioning agent, or Owner's representative. The contractor shall submit a certificate of test for review. The certificate shall give the test date, name of the refrigerant, test medium, and the field test pressure applied to the high-pressure side and the low-pressure side of the system. The certification of the test shall be signed by the contractor and witness. Certificates of systems containing 55 pounds or more of refrigerant shall be issued to the code official.

3.07 SYSTEM CHARGING

- A. Charge system using the following procedures:
 - 1. Install core in filter dryers after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.

3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.08 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 1. Open shutoff valves in condenser water circuit.
 2. Verify that compressor oil level is correct.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves except bypass valves that are used for other purposes.
 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

3.09 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.
- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.
- C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the startup procedure.
- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

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.
- B. [Section 019113 – General Commissioning Requirements.](#)

1.02 SUMMARY

- A. Section Includes:
 - 1. Ceiling-mounted ventilators.

1.03 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on actual Project site elevations.
- B. Operating Limits: Classify according to AMCA 99.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Fan speed controllers.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For unit hangars and supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - 2. Design Calculations: Calculate requirements for selecting vibration isolators[**and seismic restraints**] and for designing vibration isolation bases.

1.05 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans 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. Ceiling suspension assembly members.
 - 2. Size and location of initial access modules for acoustical tile.
 - 3. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.
- C. UL Standards: Power ventilators shall comply with UL 705.

1.08 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.01 CEILING-MOUNTED VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Loren Cook Company.
 - 3. Panasonic
- B. Housing: Steel, lined with acoustical insulation.
- C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.
- D. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

- F. Accessories:
 - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
- G. Capacities and Characteristics:
 - 1. Refer to schedule on drawings.

2.02 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- B. Enclosure Type: Totally enclosed, fan cooled.

2.03 SOURCE QUALITY CONTROL

- A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- C. Support suspended units from structure using threaded steel rods and vibration isolation. Refer to drawing schedule.. Vibration-control devices are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- D. Install units with clearances for service and maintenance.
- E. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.03 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 5. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

3.04 ADJUSTING

- A. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

3.05 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.
- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.
- C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the startup procedure.
- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

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. Insulation Materials:
 - a. Rigid Insulation Blocks.
 - b. Rigid Insulation for Elbows and Fittings
 - c. Flexible elastomeric.
 - d. Mineral fiber.
 - e. Polyisocyanurate
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Lagging adhesives.
 - 6. Sealants.
 - 7. Factory-applied jackets.
 - 8. Field-applied fabric-reinforcing mesh.
 - 9. Field-applied cloths.
 - 10. Field-applied jackets.
 - 11. Tapes.
 - 12. Securements.
 - 13. Insulation at Duct Hangers
- B. Related Sections:
 - 1. Division 23 Section "Metal Ducts" for duct liners.
 - 2. [Section 019113 – General Commissioning Requirements.](#)

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Insulation schedule indicating insulating material and thickness, service, location (interior, exterior), jacket type, and fastening method.
- C. Jacketing schedule indicating thickness, service, location (interior, exterior), color.
- D. Qualification Data: For qualified Installer.
- E. 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.
- F. Field quality-control reports.

- G. Products of one type, shall be by one manufacturer.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program, manufacturer's installation training certification or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Store tapes, adhesives, mastics, cements, and insulation materials in ambient conditions in accordance with the recommendations of the manufacturer.
- D. Follow manufacturer's recommended handling practices.
- E. Products shall contain no polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE fire retardants; whenever available.
- F. Fiber Glass and Mold: Contractor shall take precaution to protect insulation materials from moisture exposure or physical damage. Any fiber glass insulation that becomes wet or damaged shall be replaced at no additional cost.
1. HVAC duct work insulation used in the air stream must be discarded if exposed to liquid water.
- G. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
1. Piping Mockups:
 - a. One 10-foot section of NPS 2 straight pipe.
 - b. One each of a 90-degree threaded, welded, and flanged elbow.
 - c. One each of a threaded, welded, and flanged tee fitting.
 - d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
 - e. Four support hangers including hanger shield and insert.
 - f. One threaded reducer and one welded reducer.
 2. Ductwork Mockups:
 - a. One 10-foot section each of rectangular and round straight duct.
 - b. One each of a 90-degree mitered round and rectangular elbow, and one each of a 90-degree radius round and rectangular elbow.
 - c. One rectangular branch takeoff and one round branch takeoff from a rectangular duct. One round tee fitting.
 - d. One rectangular and round transition fitting.
 - e. Four support hangers for round and rectangular ductwork.

3. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
4. Notify Architect seven days in advance of dates and times when mockups will be constructed.
5. Obtain Architect's approval of mockups before starting insulation application.
6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
8. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

H. Insulation shall comply with the International Energy Conservation Code.

1.05 DEFINITIONS

- A. Thermal Conductivity (k value): BTU-in. / (hr · ft² · °F)
- B. UL Environment / GREENGUARD provides independent, third-party, Indoor Air Quality (IAQ) certification of products for emissions of respirable particles and Volatile Organic Compounds (VOC's), including formaldehyde and other specific product-related pollutants. Certification is based upon criteria used by EPA, OSHA and WHO.
- C. IAQ: Indoor Air Quality
- D. EPA: Environmental Protection Agency
- E. WHO: World Health Organization
- F. ASJ+: All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film layer leaving no paper ex-posed.
- G. ASJ: All Service Jacket
- H. SSL+: Self-sealing Advanced Closure System
- I. SSL: Self-Sealing Lap
- J. FSK: Foil-Scrim-Kraft; jacketing
- K. PSK: Poly-Scrim-Kraft; jacketing
- L. PVC: Polyvinyl Chloride
- M. FRP: Fiberglass Reinforced Plastic
- N. ECOSE® Technology: a revolutionary new binder system based on rapidly renewable bio-based materials rather than petroleum-based chemicals commonly used in other fiber glass insulation products. ECOSE Technology reduces our binder embodied energy by up to 70% and does not contain phenol, formaldehyde, acrylics or artificial colors.
- O. The UL Environment / GREENGUARD Certification Program (formerly known as GREENGUARD Indoor Air Quality Certification) gives assurance that products designed for use in indoor spaces meet strict chemical emissions limits, which contribute to the creation of healthier interiors. Achieving UL Environment / GREENGUARD Certification gives credence to manufacturers' sustainability claims, backing them with empirical scientific data from an unbiased, third-party organization.

- P. UL Environment / GREENGUARD GOLD Certification: (Formerly known as GREENGUARD CHILDREN & SCHOOLS Certification) offers stricter certification criteria, considers safety factors to account for sensitive individuals (such as children and the elderly), and ensures that a product is acceptable for use in environments such as schools and healthcare facilities. It is referenced by both The Collaborative for High Performance Schools (CHPS) and the Leadership in Energy and Environmental Design (LEED) Building Rating Systems.
- Q. UL Environment / GREENGUARD Formaldehyde Free Verification Requirements: for a product to be verified as formaldehyde free, product samples must have a measured emission factor of less than or equal to 5 µg/m² h at 24 elapsed hours or 3 µg/m² h at 336 elapsed hours. An emission factor of 5 µg/m² h, corresponds to a chamber concentration of 2.5 µg/m³ for a typical building ratio of 0.5 m²/m³. This chamber concentration is comparable to, or below typical outdoor air concentrations. This demonstrates that the formaldehyde exposure from products labeled as formaldehyde free will not contribute to airborne formaldehyde concentrations at greater levels than those found in the natural outdoor environment.
- R. Underwriter's Laboratories Environment (UL Environment / GREENGUARD): offers independent green claims validation, product assessment and certification. UL Environment / GREENGUARD provides third-party credibility for sustainable products.
- S. UL Environment Claims Validation (ECV): service and label tests a manufacturer's product and validates that the environmental claims they make in their marketing and packaging materials are factual. This Environmental Claims Validation (ECV) service will allow manufacturers to verify that their products contain a quantifiable amount of recycled content and, as such, help limit raw material extraction and reduce landfill waste. It also will enable products to qualify for LEED® points under Pilot Credit 43: MR – Certified Products.
- T. EUCEB: exonerated fiber from a health and safety standpoint by the European Certification Board process.
- U. Recycled content – post-consumer: materials such as bottled glass collected at curbside or other collection sites after consumer use and used in the manufacturing process to create a new product rather than being placed in a landfill or incinerated.
- V. Recycled content – pre-consumer (aka post-industrial): materials used or created from one manufacturing process which are collect-ed as scrap and placed back into another manufacturing process rather than being placed in a landfill or incinerated.
- W. Polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Oc-ta-BDE or Deca-BDE fire retardants: have been linked to adverse health effects after exposure in low concentrations.
- X. UL Classified: UL has tested and evaluated samples of the product with respect to certain properties of the product. UL Classifies products to:
 - 1. Applicable UL requirements
 - 2. Standards for safety
 - 3. Standards of other National and International organizations

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 size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

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 Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Rigid Insulation Blocks: High density, rigid fiberglass material intended for use as thermal insulation.
 - 1. Products: 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. Hamfab H Block
 - 2. Flame-spread index shall be 25 or less, and smoke-developed index shall be 50 or less as tested by ASTM E 84.
 - 3. Factory-Applied Jacket: ASJ-SSL. Requirements are specified in "Factory-Applied Jackets" Article.
 - 4. Service temperatures: -120° F. to +1000° F.
 - 5. Density: 18 lb. cu./ft.
 - 6. Moisture absorption: 0.2% by volume, 96 hrs. at 120° F/ 96% RH
 - 7. Corrosion: Does not cause or accelerate corrosion
 - 8. Safety: Non-combustible
 - 9. Shrinkage: None
 - 10. Dimensionally stable
 - 11. Alkalinity: Ph9
 - 12. Thermal Conductivity: K = .30 (stable, non-deteriorating)

13. Compressive strength: nominal 5% deflection at 30PSI, nominal 10% deflection at 80PSI
- G. Rigid Insulation for Elbows and Fittings: High density, rigid fiberglass or mineral wool material intended for use as thermal insulation.
1. Products: 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. Hamfab
 - b. FGH Insulation
 - c. Tru-Fit Roc 1200
 - d. Distribution International
 2. Flame-spread index shall be 25 or less, and smoke-developed index shall be 50 or less as tested by ASTM E 84.
 3. Field-Applied Jacket: PVC. Requirements are specified in "Field-Applied Jackets" Article.
 4. Service temperatures: -120° F. to +1000° F.
 5. Corrosion: Does not cause or accelerate corrosion
 6. Safety: Non-combustible
 7. Shrinkage: None
 8. Dimensionally stable
 9. Water Vapor Sorption: less than 1%
- H. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials with self-sealing adhesive lap seam. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex or ArmaFlex Ultra.
 - c. K-Flex USA; Insul-Sheet and Insul-Tube.
- I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Insulation shall be formaldehyde-free or GREENGUARD Gold Indoor Air Quality Certified and meet the GREENGUARD Gold standards for low Volatile Organic Compound (VOC) emissions. Comply with ASTM C 553, Type I and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite FSK.
 - c. Knauf Insulation; Atmosphere Duct Wrap with ECOSE Technology.
 - d. Owens Corning; SOFTR All-Service Duct Wrap.

- J. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Insulation shall be formaldehyde-free or GREENGUARD Gold Indoor Air Quality Certified and meet the GREENGUARD Gold standards for low Volatile Organic Compound (VOC) emissions. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ for all exposed locations, FSK (attic locations). Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. CertainTeed Corp.; CertaPro Commercial Board - CB 300.
- b. Johns Manville; 800 Series Spin-Glas - Type 814.
- c. Knauf Insulation; Atmosphere Air Duct Board with ECOSE technology-3.0 pcf.
- d. Owens Corning; Fiberglas 703 Series.

- K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Insulation shall be formaldehyde-free or GREENGUARD Gold Indoor Air Quality Certified and meet the GREENGUARD Gold standards for low Volatile Organic Compound (VOC) emissions. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. CertainTeed Corp.; CrimpWrap.
- b. Johns Manville; MicroFlex.
- c. Knauf Insulation; Pipe and Tank Insulation with ECOSE® Technology.
- d. Manson Insulation Inc.; AK Flex.
- e. Owens Corning; Fiberglas Pipe and Tank Insulation.

- L. Polyisocyanurate Board Insulation: Closed-cell polyisocyanurate foam core bonded on each side with a foil facer. Insulation shall be EPA-compliant hydrocarbon-based blowing agent that has zero Ozone Depletion Potential (ODP) and virtually no Global Warming Potential (GWP); CFC- and HCFC-free. Comply with ASTM C1289, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Johns Manville; XSPECT ISOfoam APF Board.
- b. Atlas; Iso-Board.
- c. Dupont; Super Tuff-R.

2.02 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Insulco, Division of MFS, Inc.; Triple I.
- b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

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. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aero seal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. Marathon Industries, Inc.; 225.
- D. 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.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. Marathon Industries, Inc.; 225.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. Red Devil, Inc.; Celulon Ultra Clear.
 - d. Proto PVC Liquid Adhesive

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. Marathon Industries, Inc.; 590.
 - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-30.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-35.
 - c. Marathon Industries, Inc.; 501.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
 - 3. Service Temperature Range: 0 to 180 deg F.
 - 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 - 5. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. Marathon Industries, Inc.; 550.
 - 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 - 4. Solids Content: 63 percent by volume and 73 percent by weight.
 - 5. Color: White.

2.05 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Marathon Industries, Inc.; 130.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

2.06 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Marathon Industries, Inc.; 405.
 - d. Pittsburgh Corning Corporation; Pittseal 444.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.07 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ + SSL+: All Service Jacket with Advance Closure System self sealing lap. All Service Jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film layer leaving no paper exposed; conforming to ASTM C 1136 Type I,II,III,IV and VII; vapor retarder; with a self-sealing adhesive.

2. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
3. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
4. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
5. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
6. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
7. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
8. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
9. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.
10. PSK facing by Knauf Insulation: White polypropylene scrim kraft complying with ASTM C1136 Type II.
11. For pipe covering, Knauf Insulation Earthwool® Redi-Klad® jacket. 5-ply weather and abuse resistant with self seal lap, Living Building Challenge-Declare Red List Free. Zero permeability per ASTM E 96-05; puncture resistance 35.4 kg (189.3 N) per ASTM D 1000; tear strength 4.3 lb(19.4N) per ASTM D 624; thickness 14.5 mils(0.0145"); tensile strength 68.0 lb./inch width{306 N (31kg)/25mm}, Excellent for Chilled Water Applications.
12. Fire Retardant: products shall contain no polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE; whenever available.

2.08 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, 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 D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: Submit color chart for selection by facility. Color of the pvc jacket shall be different for each system type.
 4. 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, traps, mechanical joints.
 5. Factory-fabricated tank heads and tank side panels.
 6. Fitting and pipe jacket shall be 25/50 flame and smoke spread rated.
 7. Thickness: 20 mil minimum.
- D. Metal Jacket:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. 0.024" thickness.
 - c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- E. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Polyguard; Alumaguard 60.

2.09 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.

- c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
- 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.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
 - 2. Width: 2 inches.
 - 3. Thickness: 3.7 mils.
 - 4. Adhesion: 100 ounces force/inch in width.
 - 5. Elongation: 5 percent.
 - 6. Tensile Strength: 34 lbf/inch in width.
 - 7. Comply with UL 181-A.

2.10 SECUREMENTS

- A. Bands:
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
 - 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
 - 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
 - 4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
- 1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CH-10.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: ONLY ACCEPTABLE FOR EQUIPMENT, TANKS AND VESSELS. NOT TO BE USED ON DUCTWORK. Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.

- d. RPR Products, Inc.

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- B. 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 equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- 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 application and finishing.
- 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. Continuous, unbroken vapor barrier is required on all below ambient service piping, ductwork, and equipment.

- K. Where vapor barrier is indicated, for joints, seams, and penetrations; insulate hangers, supports, anchors, and other projections with appropriate insulation material finishing it with a vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- M. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
 - 6. On any piping that will carry chilled liquid, create a water dam every fourth joint by sealing the butted ends of the pipe covering with the correct mastic.
- N. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness. Installed thickness shall meet the specified thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- Q. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.04 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. 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.
 - 3. Extend exterior jacket of outdoor insulation outside roof flashing to at least 2 inches below top of roof flashing.
 - 4. 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.
 - 1. Seal penetrations with flashing sealant.
 - 2. 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.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. 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. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Pipe: Install insulation continuously through floor penetrations.
 - 3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.05 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.

2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

3.06 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. Do not over compress insulation during installation to less than 75% stated thickness. Installed thickness shall meet the specified thickness.
- C. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using mitered fittings made from same material, thickness, and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with

- insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with [preformed fitting insulation.] [mitered fittings made from same material, thickness, and density as adjacent pipe insulation. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.]
 4. Insulate valves using mitered fittings made from same material, thickness, and density as adjacent pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulation and finish ends with cement.
 5. Insulate strainers using mitered fittings made from same material, thickness, and density as adjacent pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Insulate unions using removable thermal blanket insulation covers specified in the above sections.
 8. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 9. 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.
 10. Stencil the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- D. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.07 CELLULAR-GLASS INSULATION INSTALLATION

- A. Do not over compress insulation during installation to less than 75% stated thickness. Installed thickness shall meet the specified thickness.
- B. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Boxes may also be formed around valves with handle extensions through the box. Boxes shall be waterproof.

3.08 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Do not over compress insulation during installation to less than 75% stated thickness. Installed thickness shall meet the specified thickness.

B. 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.

C. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.

2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.09 MINERAL-FIBER INSULATION INSTALLATION

- A. Do not over compress insulation during installation to less than 75% stated thickness. Installed thickness shall meet the specified thickness.
- B. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- C. Insulation Installation on Pipe Flanges:
 1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- D. Insulation Installation on Pipe Fittings and Elbows:
 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- E. Insulation Installation on Valves and Pipe Specialties:
 1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

- F. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and discharge-weld insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 18 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Impale insulation over pins and attach speed washers.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 6 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
 5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Install high density, rigid insulation sections (similar to H-Block or rigid polyisocyanurate board insulation) between ductwork and support/hanger (trapeze).
 8. Insulate duct stiffeners, hangers, stands, legs, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- G. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and discharge-weld insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Do not over compress insulation during installation.
4. Install capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 12 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 12 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
5. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions. Refer to sections above for vapor stops.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
 - c. Do not over compress insulation during installation.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
8. Install high density, rigid insulation sections (similar to H-Block or rigid polyisocyanurate board insulation) between ductwork and support/hanger (trapeze).
9. Install PVC corner angles on all edges of insulated ductwork; 6ft and less above finished floor; within mechanical rooms. Apply tape and mastic on both legs of the angle to fully adhere the angles to the insulation and cover the angles.

3.10 POLYISOCYANURATE BOARD INSULATION INSTALLATION

A. Polyisocyanurate Board Installation on Ducts and Plenums Located Outdoors:

1. Top surface of ductwork shall shed water by creating a pitched surface utilizing tapered insulation. Standoffs below flat insulation to create a pitch is not acceptable.
 - a. Top surface dimension equal to and or less than 24 inches wide – create a single pitch, high point on one side and pitched to the other side.
 - b. Top surface dimension greater than 24 inches wide – create a double pitch, high point on the center of the duct and pitched to each side.

2. Install a continuous unbroken vapor barrier, aluminum field-applied jacket.
 - a. Repair punctures, tears, and penetrations with aluminum field-applied jacket vapor-barrier.
3. Install capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 12 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 12 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions. Refer to sections above for vapor stops.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
7. Install high density, rigid insulation sections (similar to H-Block or rigid polyisocyanurate board insulation) between ductwork and support/hanger (trapeze).

3.11 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth.

2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install as follows:

1. Circumferential seams shall be a minimum 1 inch overlap, and longitudinal seams shall be 1.5 to 2 inch overlap. For horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
2. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
3. PVC pipe end caps shall be provided at all piping ends wherever the pipe insulation terminates, to seal or conceal edges of the pipe insulation.
4. Cone reducers shall be provided where changes of insulation/pipe sizes occur.
5. On below ambient services, an intermediate vapor retarder compatible with PVC is required to completely seal the insulation prior to installing the PVC cover. Care should be taken to ensure that the vapor barrier mastic is applied between the pipe insulation and the fitting cover, and on fitting cover throat overlap seam. All circumferential and longitudinal seams of jackets and fitting covers should be sealed with manufacturers recommended solvent welding adhesive.
6. PVC jacketing colors shall be different for every system. Comply with the Facilities Standards color scheme; if one is not present, provide the following for all back of house and mechanical spaces:

Service (Piping and Equipment)	Jacket Color
Refrigerant	YELLOW
Coil Condensate	WHITE

7. PVC jacketing for piping located in front of house, public spaces, may be a single color or may follow the above chart. PVC jacketing color for these spaces shall be coordinated with the architect.

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.

3.12 INSULATION AT DUCTWORK HANGERS

A. For board insulation:

1. Place high density insulation board (Hamfab H-Block or polyisocyanurate) between angle iron or strut support and duct. High density insulation shall extend beyond bearing surface of duct. Duct requiring vapor barrier must not bear directly on support system.
2. Apply vapor jacket and tape. Continue the vapor barrier across high density board between duct support and insulation.
3. For board insulation over flanged duct, maintain minimum 1/2" thickness insulation beyond flange height. May require oversized insulation to be cut and material removed where flange is located. Required on outdoor air ducts and as an alternate insulation system over duct flange: apply insulation board to ductwork butting to the flange, place a 3" wide strip over top of the flange to overlap first layer of board insulation by a minimum of 1". Provide vapor barrier mastic and tape around entire perimeter.

B. For blanket insulation

1. Place high density insulation board (Hamfab H-Block or polyisocyanurate) between angle iron or strut support and duct. High density insulation shall extend beyond bearing surface of duct. Duct requiring vapor barrier must not bear directly on support system.
2. Apply vapor jacket and tape. Continue the vapor barrier across high density board between duct support and insulation.
3. For blanket insulation over flanged duct, maintain the thickness specified beyond flange height. Provide vapor barrier mastic and tape around entire perimeter.
4. For insulated duct with strap hangers, provide vapor seal tape where strap penetrates through the insulation or vapor barrier.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.14 DUCT AND PLENUM INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply, return, and outdoor air, unless otherwise noted.
2. Indoor, exposed supply, return, and outdoor air, unless otherwise noted.
3. Indoor, concealed exhaust between isolation damper and penetration of building exterior and 10 ft upstream of damper.
4. Indoor, exposed exhaust between isolation damper and penetration of building exterior and 10 ft upstream of damper.
5. Outdoor, concealed supply and return air.
6. Outdoor, exposed supply and return air.
7. Flexible duct connectors shall be insulated with blanket type insulation to allow movement.
8. And all systems/requirements indicated on the drawings schedules.

B. Items Not Insulated: unless otherwise noted.

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Factory-insulated access panels and doors.

3.15 PIPING, VALVES, FITTING, EQUIPMENT INSULATION SCHEDULE, GENERAL

A. Refer to schedule on drawings and specification requirements.

3.16 FIELD-APPLIED JACKET SCHEDULE

- A. Refer to schedule on drawings and specification requirements.
- B. All exterior ductwork shall be fitted with all-weather tight aluminum jacketing
- C. All exterior piping shall be fitted with aluminum jacketing.
- D. All interior exposed piping shall be fitted with PVC jacketing.

3.17 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.
- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.
- C. Operational Test: Rectify malfunctions, replace defective parts with new one and repeat the startup procedure.
- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

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.
- B. [Section 019113 – General Commissioning Requirements.](#)

1.02 SUMMARY

- A. Section Includes:
 - 1. Rectangular and square ceiling diffusers.
 - 2. Fixed face grilles.
- B. Related Sections:
 - 1. Section 089000 or 089119 for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, unique number identifier, and accessories furnished.
 - 3. Register, grille, and diffuser layout: Submit floor plans with all diffusers, grilles, registers and air terminal devices indicated, and tagged with the unique number identifier indicated in the submitted Diffuser, Register, and Grille Schedule mentioned above. Indicate air patterns for all air terminal devices, baffles, pattern controllers, and vanes.
 - 4. This layout shall be used by the air balance contractor in their balance report. Balance report notations and register, grille, and diffuser tags shall be coordinated with these plans.
- B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.
- C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

1.04 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

5. Duct access panels.

B. Source quality-control reports.

1.05 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: minimum 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Nailor Industries Inc.
- b. Price Industries.
- c. Krueger.

2. Devices shall be specifically designed for variable-air-volume flows.

3. Material: Steel and Aluminum.

4. Finish: custom color as selected by Architect.

5. Rectangular and Square Face Size: 24 by 24 inches and 12 by 12 inches.

6. Face Style: Plaque.

7. Mounting: Concealed and T-bar.

8. Pattern: Fixed.

9. Accessories:

- a. Equalizing grid.
- b. Safety chain.
- c. Sectorizing baffles.
- d. Plaster frames.

2.02 REGISTERS AND GRILLES

A. Fixed Face Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Nailor Industries Inc.
- b. Price Industries.
- c. Krueger.

2. Material: Steel and Aluminum.

3. Finish: custom color as selected by Architect.

4. Core Construction: Integral.

5. Frame: 1 inch wide.

6. Mounting: Concealed and Lay in.

2.03 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.
- D. Provide supplemental supports for all registers, grilles, diffusers as required for concealed mounting. Surface screws/attachments are not acceptable.
- E. Seismic restraints: Provide as specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

3.03 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns on the drawings or as directed in the shop drawings, before starting air balancing.
- B. Adjust patterns for all the register, grille and diffuser baffles, pattern controllers, and vanes of adjustable outlets to those indicated on the drawings or in the registers, grilles and diffusers shop drawing for proper distribution without drafts.

3.04 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.
- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.
- C. Operational Test: Rectify malfunctions, replace defective parts with new one and repeat the startup procedure.

- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

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. This Section includes control sequences for HVAC systems, subsystems, and equipment.
- B. Related Sections include the following:
 - 1. Division 23 Section "Instrumentation and Control for HVAC" for control equipment and devices and for submittal requirements.
 - 2. Floor plans.
 - 3. Flow and Control Diagrams.

1.03 DEFINITIONS

- A. BMS: Building Management System.
- B. VAV: Variable air volume.

1.04 GENERAL

- A. Controls contractor shall have a meeting with the architect, engineer, and owner prior to programming to discuss capabilities, schedules and sequences.
- B. Controls contractor shall allocate programming hours (not less than 20 hours) for programming of the facilities program schedules.
- C. Contractor shall provide all required control devices, meters, hardware and software to achieve the specified sequences of operation as outlined in these specifications and as detailed on drawings whether indicated and/or implied. Refer to drawing for general I/O points. All points may not be listed and are indicated for general description.
- D. BMS shall monitor and report all control function alarm points.
- E. BMS shall monitor and report status of all equipment for use in sequence of operations, trending and verification.
- F. BMS shall monitor all modulating damper positions.
- G. All setpoints including but not limited to temperature, time, CO, CO₂, enthalpy, wet bulb, pressure, etc. shall be adjustable.
- H. All safeties shall operate whether the starters are in the hand or automatic mode.
- I. Thermostats/combination space thermostats shall provide local temperature adjustment via a knob or slider bar. The temperature adjustment range shall be individually adjustable for each thermostat, programmed through the BMS or the same range can be applied to all thermostats globally.
- J. Thermostats shall also provide an occupancy override function. Activation of timed override switch on zone thermostats shall only reset zone heating and cooling setpoints to "occupied" values, but shall not affect otherwise scheduled Unoccupied operating mode of air handling unit. This allows the user to override the Unoccupied scheduled setpoints and put the system into an occupied setpoints mode for set duration and reset to normal operation at the end of the period

or whenever the override button is held for more than 5 seconds (adjustable). The override duration is individually adjustable for each thermostat through the BMS or the same range can be applied to all thermostats globally.

- K. The temperature controls contractor, equipment manufacturers, and mechanical contractor shall provide all parts, sensors, hardware and accessories for a complete and operational system. If alternate/additional sensors/relays or hardware is required by deviating from the basis of design, the control contractor is to provide all required hardware, installation and communication wiring for these devices.

1.05 SAFETIES (ALL AIR HANDLING UNITS AND DUCTWORK)

- A. Supply or return duct mounted smoke detectors; upon sensing products of combustion, or signal received from central fire alarm system, shall shut down the associated air handling system supply, return and relief fans with the HOA switch in both the "hand" and "auto" positions. Reset of smoke detector initiation shall be manual. Initiate an alarm upon shut down via duct smoke detector. BMS shall monitor status and receive trouble alarm upon detector activation.
- B. Upon building wide shutdown of air handling units from central fire alarm system, after the fire alarm is reset to normal mode, BMS shall automatically stage the re-start up of air handling units to eliminate simultaneous starting.
- C. Combination Fire/Smoke Damper control through Fire Alarm Control Panel and BMS:
 1. Combination fire/smoke dampers shall close upon activation of a signal from the central fire alarm panel, BMS signal to the central fire alarm panel, or smoke detector.
 2. Combination fire/smoke dampers shall close whenever associated HVAC system is shutdown. When HVAC system is energized on, associated combination fire/smoke dampers shall open.
 3. Smoke detectors shall be furnished by Division 26, installed in the ductwork by Division 23, wired the control system by the temperature controls contractor (provide interface panel), and wired to the fire alarm system by Division 26 (provide control modules).
 4. Upon activation of the supply or return duct smoke detector(s) of the associated system, or any area smoke detector, a signal from the fire alarm system shall shut down the system(s) fan(s) and the systems combination fire/smoke dampers via the fire alarm control modules (one to the fan and one to each FSD). Once the fire alarm system is in normal mode, the FAS shall send a signal to the BMS indicating the system is in normal mode. Upon receipt of the FAS's normal mode signal, the BMS shall send a signal to the monitoring module to open the FSD. The FAS waits for a signal from the BMS monitoring module before it controls the damper. Once the FAS receives the signal from the BMS monitoring module, the FAS sends a signal to the control module to open the FSD.
 5. Combination fire/smoke dampers shall be energized open via 120V power wired by the temperature control contractor. Coordinate circuit breaker locations with Division 26.
 6. BMS shall monitor damper end switches for all combination fire/smoke dampers, both open and closed via a connection from the fire alarm control panel to the BMS. Provide an alarm if damper position is not in the open position while building fire alarm system is in normal safe mode.
 7. The damper shall be proven open via its end switch prior to the fan being energized.
- D. Smoke Damper (duct mounted and AHU/RTU isolation dampers) control through Fire Alarm Control Panel:
 1. Smoke dampers shall close upon activation of a signal from the central fire alarm panel. When a fan system is shutdown, the BMS shall send a signal to the fire alarm system to close all smoke dampers associated with that fan system.

2. Smoke dampers shall be furnished on units >15000 cfm.
 3. Smoke detectors shall be furnished by Division 26, installed in the ductwork by Division 23, wired to the control system by the temperature controls contractor (provide interface panel), and wired to the fire alarm system by Division 26 (provide control module).
 4. Upon activation of the supply or return duct smoke detector(s) or any area smoke detector, a signal from the fire alarm system shall shut down the associated system(s) fan(s) and the associated system(s) smoke dampers. Smoke dampers shall be reset after the fire alarm system is reset to normal mode by the central fire alarm system.
 5. Smoke dampers shall be energized open via 120V power wired by the temperature control contractor. Coordinate circuit breaker locations with Division 26.
 6. BMS shall monitor damper end switches for all smoke dampers, both open and closed via a connection from the fire alarm control panel to the BMS. Provide an alarm if damper position is not in the open position while building fire alarm system is in normal safe mode.
 7. The damper shall be proven open via its end switch prior to the fan being energized.
- E. Supply duct mounted high limit pressure sensors (hard wired into safety circuits) shall shut down the supply fan when the duct static pressure exceeds 4" w.c. (adjustable) and an alarm generated at the BMS. Reset shall be manual at the BMS.
- F. The BMS shall monitor all fans status via a current sensor. If anytime the fan is enabled and current is not sensed, an alarm shall be initiated at the BMS central computer and at the local panel.
- G. The BMS shall monitor the discharge air temperature via a temperature sensor located in the supply duct. If the discharge air temperature deviates more than 5°F above or below the setpoint for a period of 5 minutes while the unit is enabled, an alarm shall be initiated at the BMS central computer and at the local panel.
- H. Following a safety shut-down, a manually initiated restart command shall restart the system as previously described under Normal Operating Mode.
- I. It is intended that, in general, the Division 23 Contractor will be responsible for all control sequences. Critical safety interlocks which are not directly wired by the Division 26 sub-contractor, such as high limit protectors, end switches etc., shall be directly connected, through wire, so as not to depend on any digital control system "Sequence of Operation" to perform their safety function.

1.06 CONTROL OF OUTSIDE AIR GENERAL (ALL AIR HANDLING UNITS)

- A. Outside air is controlled to satisfy whichever of the following predominates:
1. The outside air volume required to maintain a CO₂ differential as described below.
 2. OA intake will be limited to a maximum of the "design OA cfm" which is shown in the Schedule of Air Handling Units.
 3. The outside air volume required to provide make-up air for the exhaust systems associated with each air handler and maintain a positive building pressure.

1.07 OPTIMUM START (ALL AIR HANDLING SYSTEMS)

- A. Each air handling and hydronic system start up sequence shall include an optimal start routine. BMS shall trend time frame, based on outdoor and indoor conditions, it takes respective systems to achieve warmup/cooldown temperature setpoints. BMS shall automatically adjust startup schedules to achieve warmup/cooldown setpoints based on trended data.

1.08 NIGHT SETBACK/UNOCCUPIED MODES (ALL AIR HANDLING SYSTEMS)

- A. BMS shall reset all space temperature during unoccupied area to the following schedule:
1. All spaces except Tele/Data, IT: 65°F (adj) winter, 80°F (adj) summer.
 2. If any space drops below setback temperature, respective systems shall energize and remain in operation until space temperature rises 3°F (adjustable) above setback set point for 10 minutes (adjustable); in winter mode.
 3. If any space rises above setback temperature or dewpoint, respective systems shall energize and remain in operation until space temperature or dewpoint drops 3°F (adjustable) below setback set point for 10 minutes (adjustable); in summer mode.
 4. Building shall utilize a minimum of two space mounted relative humidity sensors (per AHU) to use in conjunction with space temperature to ensure space conditions do not exceed 60% RH in unoccupied periods.

1.09 CARBON DIOXIDE CONTROL GENERAL (ALL AIR HANDLING UNITS)

- A. BMS shall monitor room air CO2 sensors.
- B. BMS shall monitor mixed air temperature and modulate outdoor air dampers to maintain a minimum of mixed air temperature of 50°F (adjustable).
- C. The outside air dampers, bypass terminal boxes, variable air volume terminal boxes, and their associated reheat coils shall modulate to maintain room carbon dioxide levels (a maximum of 800 PPM (adjustable) above ambient CO2 levels) and temperature setpoints.
- D. An alarm shall be generated if any room CO2 sensor level rises higher than 800 PPM (adjustable) above ambient CO2 levels.
- E. Ambient CO2 levels to be provided by the outdoor air CO2 sensor located at the exterior for monitoring.
- F. In units with multiple CO2 sensors, if BMS fails to read a signal from any of the CO2 sensors or the sensor fails, an alarm shall be generated and remaining sensor(s) shall maintain control of outside air. If only a single sensor resides or failure of remaining multiple sensors, and signal or sensor failure occurs, then the units outside air dampers shall remain at last known position and an alarm shall be generated. Operator may override any failed CO2 sensor.

1.10 FIRE ALARM INTERFACE

- A. The BMS shall monitor all fire/smoke and smoke damper positions via interface with the Fire Alarm Control Panel.
- B. Alarm shall be initiated upon any smoke detector activation.

1.11 EVENT INITIATED TRENDING

- A. In the event that the temperature or humidity of any zone shall enter alarm condition, the BMS shall begin a trend of the parameters which affect the ability of the system to maintain conditions.
- B. The points trended shall be similar but not limited to:
1. Air handling unit discharge temperature.
 2. Air handling unit discharge humidity.
 3. Zone supply air temperature.
 4. Zone temperature and humidity.
 5. Outside air temperature and humidity.

- C. The BMS shall plot the variables on a single real time graphic display.
- D. The BMS shall monitor these points at 1 minute intervals and periodically download the values into Microsoft Excel.

1.12 ELECTRIC CABINET/UNIT HEATERS

- A. On a call for heat the fan shall start through manufacturer's supplied packaged controls based on the wall mounted temperature sensor. The packaged controls shall cycle the electric heating element and the unit fan to maintain the desired space temperature (setting range 45° - 70°F). Submit an alarm if space temperature drops 10°F (adjustable) below unoccupied set point.

1.13 TOILET EXHAUST FANS

- A. The fans shall be enabled and disabled through the lighting occupancy sensor. The fan shall remain on for a period of 10 minutes after the occupancy sensor has failed to detect occupancy.
- B. The BMS shall monitor the fan status via a current sensor. If anytime the fan is enabled and current is not sensed, an alarm shall be initiated at the BMS head end and at the local panel.

1.14 ELECTRICAL LIGHTING

- A. The BMS shall provide control for the site and exterior lighting. Provide five (5) lighting control points on the owner specified BMS schedule. Coordinate with the work of Division 26 and Lighting Contactor Schedule. BMS shall control normal site lighting circuits, on/off, based on exterior photocell (provided by BMS contractor) for turning on/off and user defined occupancy schedules to turn on/off. Extend control from lighting panels or contactors. Refer to Electrical drawings for locations of panels.
- B. The BMS shall provide control for the interior lighting. Provide one (1) lighting control points on the owner specified BMS schedule. Coordinate with the work of Division 26. BMS shall control lighting circuits, on/off, based on user defined occupancy schedules to turn on/off. Extend control from lighting panels or contactors. Refer to Electrical drawings for locations of panels.

1.15 MECHANICAL ROOM VENTILATION

- A. The mechanical room shall be continuously ventilated.
- B. The BMS shall monitor the fan status via a current sensor. If anytime the fan is enabled and current is not sensed, an alarm shall be initiated at the BMS central computer and at the local panel.

1.16 MONITORING POINTS

- A. The BMS shall monitor the following points via meters furnished by this division:
 1. Total domestic cold water (gpm)

1.17 DOMESTIC WATER METERING

- A. BAS to provide flow meter for domestic cold water to monitor domestic water usage.

1.18 MECHANICAL ROOM CO CONTROL

- A. Space mounted CO sensor shall shut down water heater and AC-1 if levels of CO reach 20 ppm (adjustable) ~~rise above acceptable levels~~ and a visual and audible alarm generated. Locate alarms in the corridor above all room doors. Provide local alarm silence switch. An alarm shall be generated at the BMS. Sensor shall be installed per manufacturer's instructions and NFPA 720. Sensor shall be as remotely located from the heating appliance as possible.

1.19 SPACE CO CONTROL

- A. An alarm shall be generated at the BMS if any space mounted CO sensor detects CO at ~~reaches 20 ppm (adjustable) a level above acceptable levels~~ and a visual and audible alarm generated. Locate alarms in the corridor above all room doors. Sensor shall be installed per manufacturer's instructions and NFPA 720.

1.20 MECHANICAL ROOM GAS DETECTION

- A. Space mounted gas sensor shall shut down water heater and AC-1 if level of ambient gas ~~reaches 10% of LEL (0.5% by volume) rises above acceptable levels~~ and a visual and audible alarm generated. Locate alarms in the corridor above all room doors. Provide local alarm silence switch. An alarm shall be generated at the BMS. Sensor shall be installed per manufacturer's instructions.

1.21 CONSTANT VOLUME BYPASS TERMINAL BOX AIR SYSTEMS (RTU-1, 2, 3)

- A. General
 - 1. The unit shall be enabled and disabled based on a predetermined unit operating schedule through the BMS panel located in the mechanical room. All control functions shall be accomplished through the BMS.
- B. Disabled Mode
 - 1. When the unit is disabled, the supply fan shall be off, and the outside air damper shall be closed. Gas furnace & DX cooling coil shall be off.
- C. Normal Mode
 - 1. A temp sensor downstream from the cooling coil, as reset by a return air sensor, remote zone calling for cooling and subject to maintain maximum return relative humidity at 55% will, through its controller, modulate the dx coil and compressors. The cooling coil shall modulate to maintain a supply air temperature setpoint of 55°F (adjustable). Controller shall employ a dynamic self tuning algorithm.
 - 2. The vav box heating coil and bypass damper shall modulate to maintain space setpoint.
 - 3. The BMS shall continuously monitor the position of all terminal box dampers and heating coils in zones associated with the air handling unit. The control system shall use this information to reset the supply air discharge temperature between a minimum of 55 F and a maximum of 65 F. When all reheat coils are at least partially energized, the BMS shall reset the supply air temperature upwards.
 - 4. On a call for heating, the fan discharge supply air temperature sensor modulates gas furnace. Employ a supply temperature reset schedule as with occupied summer.
 - 5. When the mixed air temperature is below 52°F, the gas furnace control valve shall modulate to maintain 55°F discharge air.
 - a. Winter: Space sensor shall modulate vav box cfm and heating coil to maintain space setpoint of 68°F (adjustable).
 - b. Summer: Space sensor shall modulate vav box cfm heating coil to maintain space setpoint of 75°F (adjustable).
- D. Unoccupied Schedule
 - 1. Outside air damper shall be open to provide makeup air for exhausts and building pressurization. Reset the space air temperature sensors to maintain space temperature at 80°F (adjustable) during a call for cooling and 65° F (adjustable) during a call for heating.

E. Cooldown or Warmup (Optimal schedule)

1. Prior to occupied operation (adjustable lead time), the supply fan shall start with VAV boxes open. After a 3 minute run time, the system reverts to a cooldown or warmup mode, depending upon return air and/or space temperature.
2. If the room temperature is above 80°F (adj), cool down commences. Air handling unit DX cooling compressors shall modulate under control of return air temperature. Normal occupied cooling resumes after room air temperature comes down to 75°F (adjustable).
3. If the room temperature is below 68°F (adj), warmup commences. Return air sensor modulates the vav box reheat coil, subject to a high limit of 95°F discharge air temp. Warmup terminates when all room temperatures have remained above 70°F for a preset time period (try 30 minutes initially). Adjust the time delay as needed to allow for thermal capacitance of building construction materials.
4. Once all spaces are satisfied, the air handling unit shall revert to the calculated supply air setpoint.

1.22 VARIABLE VOLUME TERMINAL BOX AIR SYSTEMS WITH BYPASS DAMPER (RTU-4, AC-1)

A. General

1. The unit shall be enabled and disabled based on a predetermined unit operating schedule through the BMS panel located in the mechanical room. All control functions shall be accomplished through the BMS.

B. Disabled Mode

1. When the unit is disabled, the supply fan shall be off, and the outside air damper shall be closed. Gas furnace & DX cooling coil shall be off.

C. Normal Mode

1. A temp sensor downstream from the cooling coil, as reset by a return air sensor, remote zone calling for cooling and subject to maintain maximum return relative humidity at 55% will, through its controller, modulate the dx coil and compressors. The cooling coil shall modulate to maintain a supply air temperature setpoint of 55°F (adjustable). Controller shall employ a dynamic self tuning algorithm.
2. The vav box and heating coil shall modulate to maintain space setpoint.
3. The BMS shall continuously monitor the position of all terminal box dampers and heating coils in zones associated with the air handling unit. The control system shall use this information to reset the supply air discharge temperature between a minimum of 55 F and a maximum of 65 F. When all reheat coils are at least partially energized, the BMS shall reset the supply air temperature upwards.
4. On a call for heating, the fan discharge supply air temperature sensor modulates gas furnace. Employ a supply temperature reset schedule as with occupied summer.
5. As variable air volume terminal boxes modulate their airflow to maintain space setpoints, the main bypass damper shall modulate to maintain the duct static pressure (determined during balancing).
6. When the mixed air temperature is below 52°F, the gas furnace control valve shall modulate to maintain 55°F discharge air.
 - a. Winter: Space sensor shall modulate vav box cfm and heating coil to maintain space setpoint of 68°F (adjustable).
 - b. Summer: Space sensor shall modulate vav box cfm heating coil to maintain space setpoint of 75°F (adjustable).

D. Unoccupied Schedule

1. Outside air damper shall be open to provide makeup air for exhausts and building pressurization. Reset the space air temperature sensors to maintain space temperature at 80°F (adjustable) during a call for cooling and 65° F (adjustable) during a call for heating.

E. Cooldown or Warmup (Optimal schedule)

1. Prior to occupied operation (adjustable lead time), the supply fan shall start with VAV boxes open and bypass damper closed. After a 3 minute run time, the system reverts to a cooldown or warmup mode, depending upon return air and/or space temperature.
2. If the room temperature is above 80°F (adj), cool down commences. Air handling unit DX cooling compressors shall modulate under control of return air temperature. Normal occupied cooling resumes after room air temperature comes down to 75°F (adjustable).
3. If the room temperature is below 68°F (adj), warmup commences. Return air sensor modulates the vav box reheat coil, subject to a high limit of 95°F discharge air temp. Warmup terminates when all room temperatures have remained above 70°F for a preset time period (try 30 minutes initially). Adjust the time delay as needed to allow for thermal capacitance of building construction materials.
4. Once all spaces are satisfied, the air handling unit shall revert to the calculated supply air setpoint.

1.23 DESIGN CONDITIONS

A. Outdoor Design Conditions:

1. Winter design dry bulb 0°F
2. Summer design dry bulb 87°F
3. Coincident wet bulb 73°F
4. Design dewpoint 120 grains

B. Indoor Design Conditions:

Space Design Conditions				
Space Type	Summer		Winter	
	DB °F	RH %	DB °F	RH %
Offices	75	55±5	68	NC
Classrooms	75	55±5	68	NC
Toilet rooms	75	55±5	68	NC
Storage Rooms	80	NC	65	NC
Lobby/Circulation	75	55±5	68	NC
Mechanical Rooms	NC	NC	60	NC
Circulation/Stairs	85	NC	68	NC
MDF	74	NC	74	NC
Entrance Vestibules	NC	NC	50	NC

NC – indicates no control over conditions will be provided.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

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.
- B. Section 019113 – General Commissioning Requirements.

1.02 SUMMARY

- A. Section Includes:
 - 1. Bypass, single-duct air terminal units.
 - 2. Shutoff, single-duct air terminal units.

1.03 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7, and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems".

1.04 SUBMITTALS

- A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Air terminal units.
 - 2. Liners and adhesives.
 - 3. Sealants and gaskets.
 - 4. Seismic-restraint devices.
- B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
 - 3. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Size and location of initial access modules for acoustic tile.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

- D. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Instructions for resetting minimum and maximum air volumes.
2. Instructions for adjusting software set points.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

1.06 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air terminal units that fail in materials or workmanship within specified warranty period.
1. Warranty Period: minimum 18 months from substantial completion.

PART 2 - PRODUCTS

2.01 BYPASS, SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Price.
 2. Environmental Technologies, Inc.
 3. Nailor Industries Inc.
 4. Metalaire.
- B. Configuration: Diverting-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: 0.034-inch steel, single wall.
1. Casing Lining: Adhesive attached, 3/4-inch- thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 2. Air Inlet: Round stub connection for duct attachment.
 3. Air Outlet: S-slip and drive connections.
 4. Access: Removable panels for access to diverting damper and other parts requiring service, adjustment, or maintenance; with airtight gasket.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Diverter Assembly: Galvanized-steel gate, with polyethylene linear bearings.
- E. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and

secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.

1. Access door interlocked disconnect switch.
 2. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
 3. Airflow switch for proof of airflow.
 4. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
 5. SCR Control.
- F. VAV manufacturer to provide airflow transducer, damper, and minimum 40 vA power transformer for controls.
- G. Electronic Controls: Bidirectional damper operator and microprocessor-based thermostat. Control devices shall be compatible with temperature controls specified in Section 230900 "Instrumentation and Control for HVAC" and shall have the following features:
1. Damper Actuator: 24 V, powered closed, powered open.

2.02 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Price.
 2. Environmental Technologies, Inc.
 3. Nailor Industries Inc.
 4. Metalaire.
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: 0.034-inch steel, single wall.
1. Casing Lining: Adhesive attached, 3/4-inch-thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 3. Air Outlet: S-slip and drive connections.
 4. Access Doors: Provide removable panels for access with latches upstream and downstream of coil and to parts requiring service, adjustment, or maintenance; with airtight gasket.
 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.
 2. Damper Position: Normally open.
 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- E. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and

secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.

1. SCR Control.
2. Access door interlocked disconnect switch.
3. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
4. Nickel chrome 80/20 heating elements.
5. Airflow switch for proof of airflow.
6. Fuses in terminal box for overcurrent protection (for coils more than 48 A).

F. Direct Digital Controls: Single-package unitary controller and actuator specified in Section 230900 "Instrumentation and Control for HVAC."

G. VAV manufacturer to provide airflow transducer, damper, and minimum 40 vA power transformer for controls.

2.03 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Electrogalvanized steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Hot dipped galvanized, all-thread rods and nuts.
- C. Steel cables and cable clutches are not acceptable for hanging Terminal Air Units.
- D. Air Terminal Unit Attachments: Sheet metal screws or self-tapping metal screws; compatible with duct materials.
- E. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.04 SEISMIC-RESTRAINT DEVICES

- A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- C. Restraint Cables: ASTM A 492, stainless-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; with an automatic-locking and clamping device or double-cable clips.
- D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.05 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to ARI 880.
 - 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

3.02 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Do not use powder-actuated fasteners for terminal units or seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. 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.
- E. Steel cables and cable clutches are not acceptable for hanging Terminal Air Units.

3.03 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install hangers and braces designed to support the air terminal units and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems" and ASCE/SEI 7.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on air terminal units that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items before drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Install heavy-duty sleeve anchors with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.04 CONNECTIONS

- A. Connect ducts to air terminal units according to Section 233113 "Metal Ducts."
- B. Make connections to air terminal units with rigid ductwork.
- C. Connect air terminals to main supply duct with a duct matching the inlet size of the terminal box unless otherwise indicated.

3.05 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Air terminal unit will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.07 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.
 - 4. Verify that control connections are complete.
 - 5. Verify that nameplate and identification tag are visible.
 - 6. Verify that controls respond to inputs as specified.

3.08 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

3.09 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.
- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.
- C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the startup procedure.
- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

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.
- B. [Section 019113 – General Commissioning Requirements.](#)

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Freestanding and restrained spring isolators.
 - 5. Housed spring mounts.
 - 6. Elastomeric hangers.
 - 7. Spring hangers.
 - 8. Spring hangers with vertical-limit stops.
 - 9. Pipe riser resilient supports.
 - 10. Resilient pipe guides.
 - 11. Seismic snubbers.
 - 12. Restraining braces and cables.

1.03 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.04 PERFORMANCE REQUIREMENTS

- A. Refer to structural drawings for wind speed and seismic design criteria.
- B. Importance Factor:
 - 1. The component importance factor, I_p , shall be taken as 1.5 if any of the following conditions apply:
 - a. The component is required to function for life-safety purposes after an earthquake, including fire protection sprinkler systems and egress stairways.
 - b. The component conveys, supports, or otherwise contains toxic, highly toxic, or explosive substances where the quantity of the material exceeds a threshold quantity established by the authority having jurisdiction and is sufficient to pose a threat to the public if released.
 - c. The component is in or attached to a Risk Category IV structure and it is needed for continued operation of the facility or its failure could impair the continued operation of the facility.
 - d. The component conveys, supports, or otherwise contains hazardous substances and is attached to a structure or portion thereof classified by the authority having jurisdiction as a hazardous occupancy.

2. All other components shall be assigned a component importance factor, I_p , equal to 1.0.

C. Wind-Restraint Loading:

1. Basic Wind Speed: 140 mph.
2. Refer to structural drawings for wind speed criteria.
3. All outdoor equipment subject to wind loads must have attachment calculations stamped by a professional engineer registered in the state that the project is located.

D. Seismic-Restraint Loading:

1. Seismic Design Category (SDC): Refer to structural drawings for seismic design criteria.
2. Risk Category: III
3. In Seismic Design Categories A & B: HVAC systems are exempt from requirements for seismic bracing, except for ductwork and piping crossing seismic joints.

1.05 ACTION SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind forces required to select vibration isolators, seismic and wind restraints, and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
 - a. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods,

and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

- b. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
- c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.06 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- B. Qualification Data: For professional engineer.
- C. Welding certificates.
- D. Field quality-control test reports.

1.07 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer. registered in the project state.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc. (AB)
 - 2. Kinetics Noise Control. (KNC)
 - 3. Mason Industries. (MI)
 - 4. Vibration Eliminator Co., Inc. (VE)
 - 5. Vibration Mountings & Controls, Inc. (VM&C)
 - 6. Novia, A Division of Carpenter & Patterson (N)

- B. Pads, Type NP (Neoprene Pad): Arranged in a single layer of $\frac{3}{4}$ " thick ribbed or waffled neoprene for uniform loading over pad area, molded with a nonslip pattern and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene.
Type NP isolators shall be one of the following products:
 - Type Super W.....MI
 - Type NGD.....KNC
 - Type 400N.....VE
 - Series Maxi-Flex.....VM&C
 - Type NPW.....N
- C. Pads, Type DNP (Double Neoprene Pad): Arranged in two layers of $\frac{3}{4}$ " thick ribbed or waffled neoprene, separated by a galvanized steel, stainless steel or aluminum plate. If the isolator is outdoors, the plate shall not be made of galvanized steel. These layers shall be permanently adhered together. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.
1. Resilient Material: Oil- and water-resistant neoprene.
Type DNP isolators shall be one of the following products:
 - Type Super W (Multilayers)....MI
 - Type NGD (Multilayers).....KNC
 - Type 400N (Multilayers).....VE
 - Series Maxi-Flex.....VM&C
 - Type NPW (Multilayers).....N
- D. Restrained Mounts, Type FNC (Floor Neoprene Constrained): All-directional mountings with seismic restraint.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
Type FNC isolators shall be one of the following products:
 - Type BR.....MI
 - Series RSM.....VM&C
 - Type RNM.....N
- E. Spring Isolators Type FSN (Floor Spring and Neoprene): Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.

6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
Type FSN isolators shall be one of the following products with appropriate neoprene pad (if used) selected from Type NP:
 - Type SW (Style A).....AB
 - Type SLFH.....MI
 - Type FDS B.....KNC
 - Type OST.....VE
 - Series AC.....VM&C
 - Type SM.....N
- F. Restrained Spring Isolators, Type FSNTL (Floor Spring and Neoprene Travel Limited): Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 Type FSNTL isolators shall be one of the following products with appropriate neoprene pad (if used) selected from Type NP or approved equal:
 - Type CT.....AB
 - Type SLR.....MI
 - Type FLS.....KNC
 - Type KW.....VE
 - Series AWR.....VM&C
 - Type RSM.....N
- G. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
 1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.
- H. Elastomeric Hangers Type HN (Hanger Neoprene): Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- I. Type HN isolators shall be one of the following products:
 - Type BRD.....AB
 - Type HD.....MI
 - Type RH.....KNC
 - Type 3C.....VE
 - Type RHD.....VM&C
 - Type NH.....N

- J. Spring Hangers Type HSN (Hanger Spring and Neoprene): Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- Type HSN isolators shall be one of the following products:
- | | |
|----------------------------|------|
| Type HRSA..... | AB |
| Type 30N..... | MI |
| Type SRH..... | KNC |
| Type SNRC..... | VE |
| Type RSH 30A or RSHSC..... | VM&C |
| Type RSH..... | N |
- K. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- L. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch-thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- M. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch-thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.02 RESILIENT PENETRATION SLEEVE/SEAL

- A. Resilient penetration sleeve/seals shall be field-fabricated from a pipe or sheet metal section that is 1/2" to 3/4" larger than the penetrating element in all directions around the element, and shall be used to provide a sleeve through the construction penetrated. The sleeve shall extend 1" beyond the penetrated construction on each side. The space between the sleeve and the penetrating element shall be packed with glass fiber or mineral wool to within 1/4" of the ends of the sleeve. The remaining 1/4" space on each end shall be filled with acoustical sealant to form an airtight seal. The penetrating element shall be able to pass through the sleeve without contacting the sleeve. Alternatively, prefabricated sleeves accomplishing the same result are acceptable.

Type SWS.....M.I.

2.03 RESILIENT LATERAL SUPPORTS

- A. These units shall either be a standard product of the vibration isolator manufacturer, or be custom fabricated from standard components. These units shall incorporate neoprene isolation elements similar to Type FN that are specifically designed to provide resilient lateral bracing of ducts or pipes.

Resilient lateral supports shall be one of the following products or approved equal:

Type Custom.....A.B.
Type ADA.....M.I.
Type RGN.....K.N.C.
Type VERG or VPL.....V.E.
Type MDPA.....V.M.&C.

2.04 FLEXIBLE DUCT CONNECTIONS

- A. Refer to specification section 233300 for requirements.

2.05 GROMMETS

- A. Grommets shall be made of neoprene or neoprene impregnated duck that is specially formed to prevent bolts from directly contacting the isolator base plate, and shall be sized so that they will be loaded within the manufacturer's recommended load range. Grommets shall either be custom made by combining a neoprene washer and sleeve, or be one of the following products or an approved equal:

Type Isogrommets MBIS, Inc. (Bedford Heights, OH)
Type WB Barry Controls (Brighton, MA)
Type HG.....Mason Industries Inc. (Hauppauge, NY)

2.06 ACOUSTICAL SEALANT

- A. Sealants for acoustical purposes as described in this specification shall be silicone or one of the resilient, nonhardening sealants indicated below:

Acoustical sealant D.A.P.
BR-96 or AC-20 (AC-20 FTR - Fire Rated).....Pecora
Sonoloc Sanborn
Acoustical Sealant #834 (Acrylic Latex) Tremco
Acoustical sealant U.S.G.

2.07 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanized metal components for exterior use.

3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation devices to indicate capacity range.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.
- D. General
 1. Refer to the PRODUCTS section of this specification for vibration isolation devices identified on the drawings or specified herein.
 2. The static deflections of all isolators specified herein are the minimum acceptable deflections for the mounts under actual load. Isolators selected solely on the basis of rated deflection are not acceptable and will not be approved.
- E. Major Equipment Isolation
 1. Unless otherwise shown or specified, all floor-mounted major equipment shall be set on housekeeping pads. See architectural or structural drawings for details.
 2. Types and minimum static deflections of vibration isolation devices for major equipment items shall be as scheduled on the drawings or specified hereunder.
 3. Flexible duct connections shall be installed at all fan unit intakes, fan unit discharges, and wherever else shown on the drawings.
 4. Flexible pipe connections shall be installed at all pipe connections to vibration-isolated equipment.
 5. Electrical connections to vibration-isolated equipment shall be flexible, as called for in the electrical portion of the specification.
 6. Thrust restraints shall be installed on all suspended fans and on all floor-mounted fans developing 2.5" or more of static pressure, unless the horizontal component of the thrust force can be demonstrated to be less than 10% of the equipment weight.
- F. Miscellaneous Mechanical Equipment Isolation
 1. Miscellaneous pieces of mechanical equipment, such as converters, pressure reducing stations, strainers, storage tanks, condensate receiver tanks, and expansion tanks, which are connected to isolated piping systems, shall be vibration-isolated from the building

structure by Type NP or Type HN isolators (selected for 0.1" static deflection), unless their position in the piping system requires a higher degree of isolation as called for under Pipe Isolation.

G. Duct Isolation

1. All sheet metal ducts and air plenums that are within mechanical rooms or within a distance of 50' total duct length of connected vibration-isolated equipment (whichever is longer) shall be isolated from the building structure by Type HSN or HN isolators. All isolators shall achieve 1" minimum static deflection.
2. Ducts within the specified limits that penetrate the building construction shall be isolated from the building structure by use of resilient penetration sleeve/seals.
3. Flexible duct connections shall be provided as called for above under Major Equipment and wherever shown on the drawings.

3.03 VIBRATION-CONTROL DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

B. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

C. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

E. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Use wedge type anchors only.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT

A. General

1. Locations of all vibration isolation devices shall be selected for ease of inspection and adjustment as well as for proper operation.
2. Installation of vibration isolation equipment shall be in accordance with the manufacturer's instructions.

B. Isolators

1. All vibration isolators shall be aligned squarely above or below mounting points of the supported equipment.

2. Isolators for equipment with bases shall be located on the sides of the bases which are parallel to the equipment shaft unless this is not possible because of physical constraints.
3. Locate isolators to provide stable support for equipment, without excess rocking. Consideration shall be given to the location of the center of gravity of the system and the location and spacing of the isolators. If necessary, a base with suitable footprint shall be provided to maintain stability of supported equipment, whether or not such a base is specifically called for herein.
4. If a housekeeping pad is provided, the isolators shall bear on the housekeeping pad and the isolator base plates shall rest entirely on the pad. Anchors shall be located a minimum of 6" from the edge of the pad.
5. Hanger rods for vibration-isolated support shall be connected to major structural members, not the floor slab between major structural members. Provide suitable intermediate support members as necessary.
6. Vibration isolation hanger elements shall be positioned as high as possible in the hanger rod assembly, but not in contact with the building structure, and so that the hanger housing may rotate a full 360° about the rod axis without contacting any object.
7. Parallel running pipes may be hung together on a trapeze that is isolated from the building. Isolator deflections must be the greatest required by the provisions for pipe isolation for any single pipe on the trapeze. Do not mix isolated and unisolated pipes on the same trapeze.
8. Pipes, ducts and equipment shall not be supported from other pipes, ducts and equipment.
9. Resiliently isolated pipes, ducts and equipment shall not come in rigid contact with the building construction or rigidly supported equipment.
10. Limit stops shall be out of contact during normal operation. Adjust isolators to provide 1/4" clearance between the limit stop brackets and the isolator top plate, and between the travel limit nuts and travel limit brackets.
11. Adjust all leveling bolts and hanger rod bolts so that the isolated equipment is level and in proper alignment with connecting ducts or pipes.

C. Flexible Duct Connections

1. Prior to installation of the flexible connection, sheet metal ducts and plenum openings shall be squarely aligned with the fan discharge, fan intake, or adjacent duct section, and the gap between connected parts shall be uniform. Flexible duct connections shall not be installed until this provision is met. There shall be no metal-to-metal contact between connected sections, and the fabric shall not be stretched taut.

D. Grommets

1. Where grommets are required to hold down bolts of isolators, bolt holes shall be properly sized to allow for grommets. The hold down bolt assembly shall include washers to distribute load evenly over the grommets. Bolts and washers shall be galvanized.

E. Resilient Penetration Sleeve/Seals

1. Maintain an airtight seal around the penetrating element and prevent rigid contact between the penetrating element and the building structure. Fit the sleeve tightly to the building construction and seal airtight on both sides of the construction penetrated with acoustical sealant.

3.05 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION AND/OR EXPANSION JOINTS

- A. Install u-loops or v-loops in piping and flexible connections in ductwork where they cross seismic and expansion joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in this section.
- B. Refer to the architectural and structural drawings for locations of all joints.

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
 - 6. Measure isolator restraint clearance.
 - 7. Measure isolator deflection.
 - 8. Verify snubber minimum clearances.
 - 9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.07 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.08 HVAC VIBRATION-CONTROL SCHEDULE

- A. Refer to schedule on drawings.

3.09 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.

- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.
- C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the startup procedure.
- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Work of this Division shall be governed by the Contract Documents. Provide materials, labor, equipment, and services necessary to furnish, deliver and install all work of this Division as shown on the drawings, as specified herein, and/or as required by job conditions.
- B. This Section 260100 governs general procedures, materials and workmanship as applicable to the electrical work specified in the other Division 26 sections. Refer to Division 1 sections for additional general requirements.
- C. Perform the work in accordance with the requirements and provisions of all applicable codes and laws.
- D. [Section 019113 – General Commissioning Requirements.](#)
- E. Equipment, materials, and installation shall conform to applicable standards and requirements of the following organizations and documents:

ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWS	American Welding Society
CBM	Certified Ballast Manufacturers Association
ETL	ETL Testing Laboratories
FCC	Federal Communications Commission
FM	Factory Mutual
FS	Federal Specifications
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronic Engineers
IESNA	Illuminating Engineering Society of North America
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NESC	National Electric Safety Code
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration
UL	Underwriters Laboratories, Inc.

1.02 INTENT

- A. It is the intention of the specifications and drawings to obtain finished work, clean, tested, and ready for operation.
- B. Items and services not shown on drawings, but mentioned in specifications, or vice versa, or items and services necessary to render the work complete and ready for operation, even if not specified or indicated on the drawings, shall be provided without additional cost.
- C. Where conflicts occur between drawings and specifications, or within either document, the Contractor shall ask for and obtain a written clarification from the Architect prior to submitting his

bid. Otherwise, the items or arrangements of superior quality, greater quantity or higher cost shall prevail and be included in the contract price.

1.03 WORK INCLUDED

- A. The work under this Division shall include all labor, material, equipment, services and administrative tasks required to complete and make operable the electrical work shown on the drawings and specified herein, and including, but not limited to, the following:
1. Preparation and submission of shop drawings, diagrams and illustrations.
 2. Procuring all necessary permits and approvals, and paying all required fees and charges in connection with the work of this Division.
 3. Coordinating with, and complying with requirements of, the local electric utility, telephone company, and other franchised utility and service companies as applicable to the scope of this work.
 4. Record drawings.
 5. Operating and maintenance instructions and manuals.
 6. Identification labels, tags, charts and diagrams.
 7. Final connections to all electrical equipment and devices.
 8. All cutting, drilling, and patching required for the work of this Division.
 9. Concrete housekeeping pads for floor-mounted electrical equipment.
 10. Temporary light and power for construction purposes.
 11. Testing and adjustment of all systems and equipment furnished, installed, and/or connected under this Division.
 12. Cooperation with and full participation in the commissioning process.

1.04 APPROVALS

- A. See General Conditions and Division 1 sections, in addition to the following requirements.
- B. Submit for approval a list of manufacturers of equipment proposed for the work. Contractor's intent to use exact make specified does not relieve him of responsibility for submitting such a list.
- C. Where any specific material, process or method of construction, or manufactured article is specified by name or by reference to catalog number of a manufacturer, or other standards, the intent is not to take precedence over the basic duty and performance specified, noted on drawings, or as required for intended results. In all cases, the Contractor shall verify the duty specified with the specific characteristics of the equipment offered for approval.
- D. If material or equipment is installed before it is approved, the Contractor shall be liable for its removal and replacement with no additional cost.

1.05 SUBMITTALS

- A. See Division 26 equipment sections for specific submittals required. Unless otherwise indicated, submittals are required for all electrical devices, equipment, and systems including basic construction materials such as conduit, 600 volt building wire, and standard fittings and boxes.

B. Manufacturers' Data

1. If catalog cuts of standard manufactured items show different types, options, finishes, performance requirements, or other variations, those features that the Contractor proposes to furnish shall be clearly identified. If any variations from the catalog description are proposed or required, such variations must be clearly noted on the cut.

C. Shop Drawings

1. Shop drawings shall clearly indicate all details, sectional views, arrangements, working and erection dimensions, kinds and quality of materials and their finishes, and other information necessary for proper checking and for fabrication and installation of the items, and shall include all information required for making connections to other work.
2. Shop drawings shall be numbered consecutively, and drawings related to various units comprising a proposed assembly shall be submitted simultaneously so that such units may be checked both individually and as an assembly.
3. Contractor shall keep on the site, in good order, a complete up-to-date set of approved shop drawings. Shop drawings shall be made available for inspection by the Architect.
4. The approval of shop drawings will be for general conformance to drawings and specifications, and shall not be construed as permitting any departure from the contract requirements. If the shop drawings show any variations from contract requirements because of standard shop practices or other reasons, such variations shall be clearly identified on the drawings or specifically noted in the letter of transmittal, in order that, if acceptable, suitable action may be taken for proper adjustment in other work affected thereby. If the Contractor fails to so identify such variations, he will not be relieved of responsibility for executing the work in accordance with the contract, even though such shop drawings have been approved and the work installed. Approval shall not relieve the Contractor of responsibility for any error in details, dimensions, etc. that may exist on shop drawings, nor for the furnishing of materials or work required by the contract and not indicated on the shop drawings. Approval shall not be construed as approved departure from details or instructions previously furnished by the Architect.
5. No work for which shop drawings are required shall be executed until the Architect's approval is obtained.

D. Shop Drawing Schedule

1. The Contractor shall submit, within 30 days of the award of his contract, a schedule of all proposed shop drawing submissions.
2. The schedule shall include the following information.
 - a. Item to be submitted
 - b. Date of submission
 - c. Latest date for review
 - d. Manufacturers of the specified item.
3. Items not specifically listed as "approved equal" should be listed for consideration at this time.
4. Shop drawings require a minimum of 10 business days from the date they have been received by the Consulting Engineer's office to adequately review the submittal. If there is any submittal which requires to be expedited sooner than the 10 business days, the Engineer shall be informed in writing at the beginning of construction with a list of those submittals.

- E. Operating and Maintenance Instructions
1. Furnish manufacturer's operating and maintenance instructions, parts lists, and sources of supply for replacements.
- F. Submittals will be reviewed for conformance with the contract drawings and specifications. The engineer's review stamp will be affixed to submittals. One of the following actions will be taken:
1. Reviewed:
 - a. No comments, corrections, or marks have been made to the submittal. Re-review by the engineer is not required. The submittal is in general conformance with the design concept. Construction, fabrication and/or manufacture can proceed subject to the provision that the work shall be in accordance with the requirements of the Contract Documents. Final acceptance of the work shall be contingent upon such compliance.
 2. Furnish As Corrected
 - a. Comments, corrections, or marks made. Re-review is not required. Submission is in general conformance with the design concept subject to notations on the returned Submittal. Construction, fabrication, and/or manufacturer can proceed subject to the provisions that the work shall be carried out in compliance with all annotations and/or corrections indicated on the returned Submittal and in accordance with the Contract Documents. Final acceptance of the work shall be contingent on such compliance.
 3. Revise and Resubmit
 - a. Significant issues/discrepancies/incomplete information was provided in the Submittal. Revise or prepare a new submittal in accordance with the notations and Contract Documents. Resubmit without delay.
 4. Rejected
 - a. Submittal does not meet Contract document intent. Revise or prepare a new submittal in accordance with the notations and Contract Documents. Resubmit without delay.
- G. A submittal review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Corrections or comments made on the shop drawings during this review do not relieve the contractor from Compliance with the requirements of the plans and specifications. Approval of a specific item shall not include approval of an assembly of which the item is a component. The contractor is responsible for: dimensions to be confirmed and correlated at the jobsite; information that pertains solely to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination of his or her work with that of all other trades; and for performing all work in a safe and satisfactory manner.

1.06 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- E. Upon installation of back boxes for devices but prior to installation of raceway to same the contractor shall notify the Owner, Architect and Engineer at least two weeks prior so that a site visit for review of back box locations may be performed. Contractor shall promptly be given marked up directions indicating which back boxes are to be relocated. Relocation of back boxes as a result of the site review shall be performed at no additional cost to the Owner.

1.07 RECORD DRAWINGS

- A. Provide record drawings in accordance with contract requirements, indicating in a neat and accurate manner a complete record of all revisions to the original design of the work. Include all changes and an accurate record, on reproductions of the contract drawings or appropriate shop drawings, of all deviations between the work shown and the work installed.
- B. The contractor shall provide a complete set of as-built drawings. Drawings shall be submitted in both hard copy and electronic (AutoCAD and Revit version as required by the Owner) version or AutoCAD Version 2018 if not specified. Number of copies of each as requested by the Owner. PDFs inserted into an AutoCad file are not acceptable.
- C. The as-built drawings shall reflect as installed conditions including all addenda, and miscellaneous revisions. The contractor shall make necessary modifications to the as-built drawings based upon the review submission comments. The final product shall include a copy of all electronic files of all as-built drawings of size and format consistent with the project standards.

1.08 GUARANTEES AND SERVICES

- A. All workmanship, installation materials, and equipment shall be guaranteed as specified in the General Conditions and Division 1.

- B. Contractor shall leave entire system installed under this Contract in proper working order, and shall replace any work or material which develops defects within the guarantee period, including all other work damaged as a result of such defects, without additional cost.

1.09 PERMITS AND CERTIFICATES

- A. Prior to proceeding with any installation, the Contractor shall prepare and submit to the proper authorities for their approval all working drawings required by them, and shall give all necessary notices, obtain all permits, and pay all local, state and federal taxes, fees and other costs in connection with this work.

1.10 EQUIPMENT MANUALS AND OPERATING INSTRUCTIONS

- A. Provide the following:
 - 1. Three complete sets of final and correct shop drawings, maintenance and replacement parts manuals, and operating instructions for the equipment supplied. Bind each set within a common binder. Index, number, and organize with a table of contents to permit quick and convenient reference.
 - 2. Three days of instruction in operation and maintenance of equipment to Owner's maintenance force during a 2-week period. Designate a 2-week period, convenient to the Owner, during which qualified personnel, including manufacturers' technicians and engineers, will be available for Owner's instructions.

1.11 SHORT CIRCUIT, OVERCURRENT PROTECTION SELECTIVE COORDINATION, AND ARC FLASH STUDY

- A. The contractor shall perform and submit for review and approval (1) a short circuit study, (2) an overcurrent protection selective coordination study, (3) an arc flash study in accordance with IEEE "Red Book" Standard 141 for all service and distribution equipment supplied, including, but not limited to, equipment specified in Sections, and 262416 Panelboards. Study reports shall accompany submittals for above equipment. **Submittals for the above items submitted without study reports shall be rejected.** If the report is not submitted with the equipment submittals, then the contractor shall replace any overcurrent protection device or equipment as required to meet the short circuit and selective coordination requirements at no additional cost to the Owner.
- B. Manufacturer shall document that overcurrent protection devices will perform in accordance with their U.L. listings and ANSI/IEEE Standard 242.
- C. The contractor shall be responsible for final field adjustment of ground fault, overload and short circuit settings of adjustable circuit breakers and fused devices in compliance with the short circuit and coordination study recommendations.

PART 2 - PRODUCTS

2.01 MATERIALS, EQUIPMENT AND SYSTEMS

- A. Materials and equipment and systems shall be new, bear manufacturer's name and trademark, and comply with applicable standards specified.
- B. The UL label shall be borne on each piece of applicable material or equipment.

- C. Equipment shall be provided with all required hardware for proper installation, assembly, and operation.
- D. The descriptions cover basic equipment and operation but not all the details of design and construction. The use of singular in descriptions does not limit the quantities of items to be furnished to provide the operation specified. Furnish all equipment required to produce specified performance under installed conditions. Provide all trim, enclosures and accessories required to make a complete installation.
- E. Follow manufacturers' directions in delivery, storage, protection and installation of equipment and materials. Notify Architect promptly, in writing, of any conflict between requirements of the contract documents and manufacturers' directions, and obtain Architect's written instructions before proceeding with work. Bear all costs to correct deficiencies arising from failure to comply with the manufacturers' directions and instructions.
- F. Deliver equipment and materials to the site and store in original containers, suitably sheltered from the elements. Store items subject to moisture damage in dry, heated spaces. Tightly cover and protect equipment against dirt, water, chemical, and mechanical injury, and against theft.
- G. Equipment and materials of the same general type shall be of the same manufacturer, make and model throughout the work to provide uniform appearance, operation and maintenance.
- H. Where new products or components are indicated to be installed or connected to existing systems or equipment, verify compatibility and performance with the manufacturer of the existing systems or equipment prior to purchase and installation.
- I. Where devices and/or equipment are indicated to be relocated, conductors and raceway shall be extended to the new location and reconnected to provide a complete working system. If there are associated devices with the relocated equipment they shall be relocated as well, unless otherwise noted, and connected into the system.

2.02 EQUIPMENT DEVIATIONS

- A. Where Contractor proposes to use an item of equipment other than that specified or detailed on the drawings, and which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the mechanical or electrical layouts, such redesign and new drawings required thereby, with approval of the Architect, shall be prepared by the Contractor without additional cost.
- B. Where such approved deviation requires a different quantity or arrangement of equipment from that specified or indicated on the drawings, the Contractor shall provide any structural supports, controllers, motors, starters, wiring, conduit, and any other additional equipment required by the deviation, at no additional cost.
- C. It is the intent of these specifications that wherever a manufacturer of a product or a catalog number is specified, and terms "or equal" or "or approved equal" are used, a substituted item must conform in all essential respects to the specified item. Consideration will not be given to claims that a substituted item meets performance requirements with lesser construction. Performance as indicated in schedules and in specifications shall be interpreted as minimum acceptable performance.

PART 3 - EXECUTION

3.01 SITE INVESTIGATION

- A. Examine drawings, specifications, and site, and be responsible for the nature and location of work and the general and local conditions, particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, electric power, roads, etc.

3.02 DRAWINGS

- A. Drawings are diagrammatic and indicate the general arrangement of systems and work required. Do not scale the drawings. Consult the Mechanical and Architectural drawings and details for exact locations of equipment.
- B. Drawings shall be used in layout of work. Check reference drawings to verify spaces in which work will be installed, and maintain maximum headroom and space conditions. Where headroom, working clearances or space conditions appear inadequate, Architect shall be notified before proceeding with installation.
- C. If directed by the Architect, make minor modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

3.03 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Equipment Mounting: Install floor mounted equipment on concrete base, 4" height with 1" 45-degree chamfer extended 3" from equipment footprint. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete." or Section 033053 "Miscellaneous Cast-in-Place Concrete."
- F. Right of Way: Give to piping systems installed at a required slope.

3.04 COORDINATION WITH OTHER TRADES

- A. Closely schedule the work so that the work will be installed at the proper time and without delaying the project's completion.
- B. Where the work of this Division is to be installed in close proximity to the work of other trades, or where there is evidence that the work will interfere with the work of other trades, assist in working out space conditions to make a satisfactory arrangement. If the work is installed before such

coordination with other trades, make necessary changes in the work as directed by the Architect to correct any conflicts or interferences, without additional cost.

3.05 COORDINATION AND LAYOUT

- A. Study drawings and specifications to ensure completeness of work required. Include supplementary items normal to manufacturers' requirements or standard accepted trade practices as necessary to complete the work, even if not explicitly shown or specified.
- B. Verify measurements and conditions in field before starting work.
- C. Examine materials, surfaces, and structures to which work is to be applied and notify the Architect, in writing, of any conditions which are detrimental to proper and expeditious installation of work. Starting of work shall be construed as acceptance of conditions.
- D. Confer with other trades to install work to avoid interference with other trades. The necessary adjustments to conform to structural conditions and work of other trades, particularly ductwork and piping layouts, is included under this section. Assist other trades in the preparation of coordinated layout drawings.

3.06 CONNECTIONS TO EQUIPMENT FURNISHED UNDER OTHER DIVISIONS OR BY OWNER

- A. Provide electrical connections to equipment and fixtures requiring such connections which are supplied by Owner or under other Divisions.
- B. Provide conduit, wire, fittings, accessories, and trim for final connection of each item of equipment as required for complete assembly and specified operation.
- C. Verify with approved project submittals that power conductor's meet both project as well as manufacturer requirements prior to conductor procurement and installation.
- D. Verify conductor material and specified size are compatible with equipment to be connected to.
- E. Notify architect and design team of identified issues prior to conductor procurement and installation.
- F. Proceed with procurement and installation only after unsatisfactory conditions have been corrected.

3.07 WORKMANSHIP

- A. Perform work in practical, neat, and workmanlike manner, with electricians skilled in the work they are performing, and using the best generally recognized trade practices.
- B. No work shall be covered or hidden from view until it has been inspected and approved by the required Building Department personnel and the Architect.
- C. Workmanship or materials not meeting with requirements of the specifications or drawings, or the satisfaction of the Architect, shall be rejected and shall be immediately replaced in an acceptable manner without additional cost.

3.08 TESTS

- A. Test all wiring, lighting fixtures, switches, controllers, starters, motors, etc., wired under this Division. Leave free from grounds, crosses, shorts, opens, etc., and leave materials and apparatus in proper and satisfactory working condition. Perform additional tests as listed in the other Division 26 specification sections.
- B. Furnish necessary meters, instruments, temporary wiring, and skilled labor to perform tests and adjustments. Measuring instruments shall be properly calibrated.
- C. Prior to energizing, test insulation resistance of conductors as per the requirements of specification 260519 Conductors and Cables.
- D. Prior to energizing, test for continuity and identification of each conductor. Identify both ends of each conductor.
- E. Perform additional tests required by Owner, Architect or any other authorities having jurisdiction.
- F. Correct or replace any circuit, material or equipment which is found to be defective by these tests. Correct defects, whether due to faulty workmanship or material furnished, in a manner acceptable to Engineer without additional cost.
- G. Test for proper operation of emergency lighting equipment under simulated emergency conditions.
- H. Test all distribution equipment, motors, and three phase receptacles for proper phase connections and phase rotation. Correct as required.
- I. Notify Architect, in writing, at least one week prior to tests, of the proposed testing timetables. Perform tests with the approval of and in the presence of the Architect or his representative.

3.09 IDENTIFICATION

- A. Equipment
 - 1. Identify each item and the system or area it serves. Provide an engraved multilayer, multicolor, plastic nameplate in a visible location on each disconnect, switch, control and similar accessory. Provide stencils on all major equipment.
 - 2. All switchboard devices, panels, cabinets, junction boxes, switches, controllers, etc., shall be identified as to systems, voltage, phases, etc., on their exteriors.
- B. Wiring
 - 1. Provide fiber tags for feeders and branch circuits in pull boxes, cabinets, and outlets to identify each feeder and circuit.
 - 2. All cables and branch wiring shall be identified showing phasing, system designations, and items served. Identity is required in switchboards, panels, junction boxes, switches, controllers, cabinets, etc.
- C. Provide complete, accurate, typewritten panelboard and switchboard directories mounted securely to panelboard doors and switchboard faces.

3.10 TEMPORARY LIGHT AND POWER

- A. Contractor shall furnish, install and maintain a temporary light and power system to provide the buildings, field offices, and project site with temporary light to provide safe working conditions throughout, and to supply construction power as required on the job.
- B. The system shall be furnished, installed, and operating at the earliest possible date.
- C. All work for the system shall be in accordance with NEC Article 590, the requirements of the Utility Company, and as approved by the Owner and authorities having jurisdiction.
- D. The work shall include generally, but not be limited to, the following:
 - 1. Make all arrangements with the utility company or the Owner to furnish and install the temporary light and power service.
 - 2. Review and coordinate the electrical needs of all trades on a continuing basis, until permanent power and light is available and the temporary system is removed and no longer needed.
 - 3. Furnish, install, and maintain all required temporary system equipment, devices, and wiring. Remove when no longer needed, or at the direction of the Owner. Modify, add, or relocate equipment, devices, and wiring as required to suit job conditions.

3.11 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.
- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.
- C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the startup procedure.
- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

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.
- B. [Section 019113 – General Commissioning Requirements.](#)

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Snap switches.
 - 3. Low voltage wall-box control devices.
 - 4. Combination occupancy/vacancy sensors.
 - 5. Daylight sensors.
 - 6. Floor service outlets.

1.03 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. UTP: Unshielded twisted pair.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.
- F. Contractor shall perform a coordination review with the lighting fixture vendor and the wiring device submittal to ensure that the wiring devices are compatible with the lighting fixtures they are controlling and shall submit a letter with the shop drawing. If letter is not included, then shop drawing shall be automatically rejected.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.06 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace devices that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One years from date of Substantial Completion.

1.08 EXTRA MATERIALS

- A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Service Outlet Assemblies: 1 for every 10, but no fewer than 1.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. ABB Installation Products (ABB).
 - 2. Cooper Wiring Devices; a division of Eaton (Eaton).
 - 3. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 4. Leviton Mfg. Company Inc. (Leviton).
 - 5. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.02 STRAIGHT BLADE RECEPTACLES

- A. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Eaton; TRBR20.
 - b. Hubbell; BR20__TR.

- c. Leviton; TBR20.
 - d. Pass & Seymour; TR20.
 - 2. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.
- B. Tamper Resistant Controlled (Switched) Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Eaton; TR5362CD for both outlets marked and the TR5362CH for one outlet marked.
 - b. Hubbell; BR20C2_TR for both outlets marked and the BR20C1_TR for one outlet marked.
 - c. Leviton; 5362-2P for both outlets marked and the 5362-1P for one outlet marked.
 - d. Pass & Seymour; TR5362CD for both outlets marked and the TR5362CH for one outlet marked.
 - 2. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.03 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Weather Resistant, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with UL WC-596.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Eaton; WRSGF20F.
 - b. Hubbell; GFWRST20.
 - c. Leviton; GFWR2
 - d. Pass & Seymour; WR5362.
 - 2. To be provided where "WP" is indicated next to a receptacle.

2.04 TAMPER RESISTANT GFCI RECEPTACLES

- A. General Description: Decora Style, Tamper Resistant, Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Eaton; TRSGF20.
 - b. Hubbell; GFTRST20.
 - c. Leviton; GFTR2.
 - d. Pass & Seymour; 1595SWTTR.

2.05 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Eaton; CSB120 (single pole), CSB220 (two pole), CSB320 (three way), CSB420 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
 - d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

2.06 LOW VOLTAGE WALL-BOX CONTROL DEVICES

- A. Low voltage switches:
 - 1. Refer to drawings.
- B. Low voltage dimmers:
 - 1. Refer to drawings.
- C. Low voltage scene control stations:
 - 1. Refer to drawings.

2.07 COMBINATION OCCUPANCY/VACANCY SENSORS

- A. Wall-Switch Sensors:
 - 1. Products: Subject to compliance with requirements, provide the following or equivalent:
 - a. Current; LHRDCMTD.
 - 2. Description: Dual-technology type, dual relay, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 1,000 sq. ft.
 - 3. Contractor shall provide a relay above the ceiling in an enclosure that shall be controlled by the wall switch and is intended for use with the BMS system.
- B. Wall-Dimmer Sensors:
 - 1. Products: Subject to compliance with requirements, provide the following or equivalent:
 - a. Current; LHRDMMTS2.
 - 2. Description: Dual-technology type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 1,000 sq. ft.
 - 3. Contractor shall provide a relay above the ceiling in an enclosure that shall be controlled by the wall switch and is intended for use with the BMS system.

- C. Wall Mounted Sensors:
 - 1. Dual-technology type. Refer to drawings.
- D. Ceiling Mounted Sensors:
 - 1. Dual technology type. Refer to drawings.

2.08 DAYLIGHT SENSORS

- A. Ceiling Mounted Daylight Sensors:
 - 1. Refer to drawings.

2.09 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof "In-Use" Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.10 FLOOR SERVICE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Legrand Evolution Series
- B. Material: Epoxy coated sheet metal or sheet metal. Epoxy coated sheet metal boxes shall be used for boxes in concrete slabs on grade only. Sheet metal boxes shall be used for boxes in concrete slabs above grade.
- C. Type: Modular, Recessed-type, dual-service units suitable for wiring method used, 4 gangs minimum, 2 gangs for power, 2 gangs for low voltage.
- D. Compartments: Barrier separates power from voice and data communication cabling.
- E. Service Plate: Round or rectangular as per architect, finish as per architect.
- F. Power Receptacle: NEMA WD 6 configuration 5-20R, refer to drawings for quantities, white finish, unless otherwise indicated. Controlled (switched) receptacles shall be permanently marked.
- G. Voice and Data Communication Outlet: Space for a minimum of four modular, keyed, color-coded, RJ-45 jacks for UTP cable.
- H. Electrical contractor shall review the structural drawings to determine which specified box is appropriate for the depth of the slab.

2.11 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:
 - 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 - 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. 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 left.
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. 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, multigang wall plates.

I. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

3.02 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use press on label, black lettering on white background on face of plate and in easily readable location inside device backbox, and durable wire markers or tags on conductors inside outlet boxes.

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or

similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

3.04 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.
- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.
- C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the startup procedure.
- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

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.
- B. [Section 019113 – General Commissioning Requirements.](#)

1.02 SUMMARY

- A. Section includes:
 - 1. Copper cable test device
 - 2. Cable Test Results and testing procedures
 - 3. As-built drawings
- B. Related Requirements:
 - 1. Not applicable.
- C. Alternates: Not Applicable.
- D. Items To Be Installed Only: Not Applicable.
- E. Items To Be Furnished Only: Not Applicable.

1.03 SCOPE

- A. Testing shall be performed on each cabling link (connector to connector - 100% testing).
 - 1. Testing shall be performed on each cabling channel (equipment to equipment) that is identified by the owner.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 1. Installation Supervision: Installation shall be under the direct supervision of an ITS Technician, who shall be present at all times when Work of this Section is performed at Project site.
 - 2. Field Inspector: Currently registered by BICSI as a registered communications distribution designer (RCDD) to perform the on-site inspection.
- B. All testing procedures and field-test instruments shall comply with applicable requirements of:
 - 1. ANSI/TIA-1152, Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
 - 2. ANSI/TIA-568.0-E, Generic Telecommunications Cabling for Customer Premises.
 - 3. ANSI/TIA-568.1-E, Commercial Building Telecommunications Cabling Standard
 - 4. ANSI/TIA 568.2-D, Balanced Twisted-Pair Telecommunications Cabling and Components Standards.
 - 5. ANSI/TIA-606-C, Administration Standard for Commercial Telecommunications Infrastructure, including the requirements specified by the customer, unless the customer specifies their own labeling requirements.

- C. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
 - 1. Manufacturer of the copper cable and connectors.
 - 2. Manufacturer of the test equipment used for the field certification.
 - 3. Training organizations (e.g., BICSI, A Telecommunications Association headquarters in Tampa, Florida; ACP [Association of Cabling Professionals™] Cabling Business Institute located in Dallas, Texas)
- D. The Owner or the Owner's representative shall be invited to witness and/or review field-testing.
 - 1. The Owner or the Owner's representative shall be notified of the start date of the testing phase five (5) business days before testing commences.
 - 2. The Owner or the Owner's representative will select a random sample of five percent of the installed links. The Owner or the Owner's representative shall test these randomly selected links and the results are to be stored in accordance with Part 3 of this document. The results obtained shall be compared to the data provided by the installation contractor. If more than two percent of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the representative shall repeat one hundred percent testing at no cost to the Owner.

1.05 SUBMITTALS

- A. Manufacturers catalog sheets and specifications for the copper cable test equipment
- B. A schedule (list) of all balanced twisted-pair copper links to be tested.
- C. Sample test reports.

1.06 ACCEPTANCE OF TEST RESULTS

- A. Unless otherwise specified by the Owner or the Owners representative, each Category 6 cabling link shall be tested for:
 - 1. Wire Map
 - 2. Length
 - 3. Propagation Delay
 - 4. Delay Skew
 - 5. DC Loop Resistance – recorded for information only
 - 6. DC Resistance Unbalance – recorded for information only
 - 7. Insertion Loss
 - 8. NEXT (Near-End Crosstalk)
 - 9. PS NEXT (Power Sum Near-End Crosstalk)
 - 10. ACR-N (Attenuation to Crosstalk Ratio Near-End) – recorded for information only
 - 11. PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End) – recorded for information only
 - 12. ACR-F (Attenuation to Crosstalk Ratio Far-End)
 - 13. PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End)
 - 14. Return Loss
 - 15. TCL (Transverse Conversion Loss) – recorded for information only
 - 16. ELTCTL (Equal Level Transverse Conversion Transfer Loss) – recorded for information only

- B. Unless otherwise specified by the Owner or the Owners representative, each Category 6A cabling link shall be tested for:
1. Wire Map
 2. Length
 3. Propagation Delay
 4. Delay Skew
 5. DC Loop Resistance
 6. DC Resistance Unbalance within a pair
 7. DC Resistance Unbalance between pairs
 8. Insertion Loss
 9. NEXT (Near-End Crosstalk)
 10. PS NEXT (Power Sum Near-End Crosstalk)
 11. ACR-N (Attenuation to Crosstalk Ratio Near-End)
 12. PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End)
 13. ACR-F (Attenuation to Crosstalk Ratio Far-End)
 14. PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End)
 15. Return Loss
 16. TCL (Transverse Conversion Loss)
 17. ELTCTL (Equal Level Transverse Conversion Transfer Loss)
 18. PS ANEXT (Power Sum Alien Near-End Crosstalk) – sampled per section 3.02.
 19. Average PS ANEXT (Average Power Sum Alien Near-End Crosstalk) – sampled per section 3.02.
 20. PS AACR-F (Power Sum Alien Attenuation to Crosstalk Ratio Far-End) – sampled per section 3.02.
 21. Average PS AACR-F (Average Power Sum Alien Attenuation to Crosstalk Ratio Far-End) – sampled per section 3.02.
- C. Unless otherwise specified by the Owner or the Owners representative, each cabling link shall be in compliance with the following test limits:
- D. All installed cabling permanent links and channels shall be field-tested and pass the test requirements and analysis as described in Part 3. Any permanent link or channel that fails these requirements shall be diagnosed and corrected. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected permanent link or channel meets performance requirements. The final and passing result of the tests for all permanent links and channels shall be provided in the test results documentation in accordance with Part 3.
- E. Acceptance of the test results shall be given in writing after the project is fully completed and tested in accordance with Contract Documents and to the satisfaction of the Owner.
- F. Note: High Bandwidth applications such as 1000BASE-SX, 10GBASE-SR, and FC1200 impose stringent channel loss limits. Where practical, certification should consider loss length limits that meet maximum channel (transmitter to receiver) loss. 0.75 dB per connector pair loss may not support the intended application.

PART 2 - PRODUCTS

2.01 CABLE TEST DEVICE

- A. Products: Subject to compliance with requirements, provide the following:
1. Fluke DTX Cable Analyzer, Model No. DSX-5000 and DSX 8000

2.02 BALANCED TWISTED-PAIR CABLE TESTER

- A. Must meet or exceed TIA Level IV compliant network cable-testing device certification by an independent laboratory, such as Intertek, for verification of high speed, TIA T568 compliant cables.
- B. Copper test equipment must be capable of certifying Category-3, Category-5e, Category 6 and Category 6A UTP/ScTP links or channels independent of termination hardware configuration (RJ45 port or 110-style) for each level of performance.
- C. Provide full 2-way Autotest of Category-3, 5e, 6, and 6A twisted pair links.
- D. All test equipment shall be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.
- E. The field-test instrument shall be within a 12 month calibration period.
- F. Results Storage
 - 1. Must be capable of storing > 10,000 results for all measurements found in 2.02G below
- G. Measurement capabilities
 - 1. Wire Map
 - 2. Length
 - 3. Propagation Delay
 - 4. Delay Skew
 - 5. DC Loop Resistance
 - 6. DC Resistance Unbalance within a pair
 - 7. DC Resistance Unbalance between pairs
 - 8. Insertion Loss
 - 9. NEXT (Near-End Crosstalk)
 - 10. PS NEXT (Power Sum Near-End Crosstalk)
 - 11. ACR-N (Attenuation to Crosstalk Ratio Near-End)
 - 12. PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End)
 - 13. ACR-F (Attenuation to Crosstalk Ratio Far-End)
 - 14. PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End)
 - 15. Return Loss
 - 16. TCL (Transverse Conversion Loss)
 - 17. ELTCTL (Equal Level Transverse Conversion Transfer Loss)
 - 18. Time Domain Reflectometer
 - 19. Time Domain Xtalk Analyzer
 - 20. PS ANEXT (Power Sum Alien Near-End Crosstalk)
 - 21. Average PS ANEXT (Average Power Sum Alien Near-End Crosstalk)
 - 22. PS AACR-F (Power Sum Alien Attenuation to Crosstalk Ratio Far-End)
 - 23. Average PS AACR-F (Average Power Sum Alien Attenuation to Crosstalk Ratio Far-End)
- H. Accessory Products:
 - 1. Interface Adapters
 - a. TIA Category-3, 5e, 6 and 6A: 100 ohm
 - b. Category/Class E permanent link adapters for TIA Cat 3, 5e 6, and 6A unshielded and shielded cables.
 - 1) RJ45 plug must meet the requirements for NEXT, FEXT and Return Loss in accordance with ANSI/TIA-568.2-E Annex C

- 2) Twisted pair Category 5e, 6, 6A, 7 or 7A cords are not permitted as their performance degrades with use and can cause false Return Loss failures

2.03 ADMINISTRATION

- A. Administration of the documentation shall include test results of each copper Permanent Link and channel.
- B. The test result information for each link shall be recorded in the memory of the field-test instrument upon completion of the test.
- C. The test result records saved within the field-test instrument shall be transferred into a Windows® -based database utility that allows for the maintenance, inspection and archiving of these test records.
- D. Alien Crosstalk measurements shall be stored to a PC upon completion of the test.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Check actual site conditions prior to start of any work. Ensure all preceding trade work associated with the telecommunications system is accurate and complete before proceeding with installation or use of products specified in this section.
- B. Verify telecommunications cabling is installed and supported, terminated, mounted in an appropriate housing or terminated on the applicable component and labeled prior to certification testing and documentation.
- C. Verify certification tester universal interface adapters and manufacturer patch cords that enable permanent link verification are in new condition not indicating any twisting or kinking resulting from incorrect storage of the tester interface adapters.
- D. All outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to field-testing. Any testing performed on incomplete systems shall be redone on completion of the work.

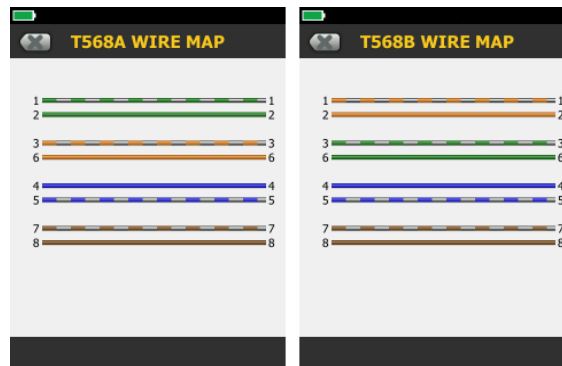
3.02 BALANCED TWISTED PAIR CABLE TESTING

- A. Field-test instruments shall have the latest firmware installed.
- B. Permanent Link test results, including the individual frequency measurements from the tester, shall be recorded in the test instrument upon completion of each test for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.
- C. Permanent Link testing shall be performed on each cabling segment (connector to connector). Sampling is not acceptable.
- D. Alien Crosstalk testing shall be performed using a sampling plan. An acceptance quality level (AQL) of 0,4 %, normal inspection, general inspection level I as defined in ISO 2859-1 for populations of up to 500,000 links shall be used. The following table represents this sampling level.

Total number of links (N)	Sample size (No. of links to test)
3 – 33	3 or 0.1 x N (whichever is greatest)
34 – 3,200	33

Total number of links (N)	Sample size (No. of links to test)
3,201 – 35,000	126
35,001 – 150,000	201
150,001 – 500,000	315

- E. Disturbed (Victim) links chosen for Alien Crosstalk testing shall be an equal combination of short, medium and long links.
- F. Permanent Link adapters made from twisted pair Category 5e, 6, 6A, 7 or 7_A cords are not permitted as their performance degrades with use and can cause false Return Loss failures.
- G. The installer shall build a reference link. All components shall be anchored so it is not possible to disturb them. The technician is to conduct a Category 6 and 6A Permanent Link test each day to ensure no degradation of the tester or its Permanent Link adapters.
- H. Wire Map Measurement
- The wire map test is intended to verify pin-to-pin termination at each end and check for installation connectivity errors.
 - For each of the eight conductors in the cabling, the wire map indicates:
 - Continuity to the remote end
 - Shorts between any two or more conductors
 - Reversed pairs
 - Split pairs
 - Transposed pairs
 - Distance to open on shield
 - Any other miss-wiring
 - The correct connectivity of telecommunications outlets/connectors is defined in ANSI/TIA-568.2-E. Two color schemes are permitted. The user shall define which scheme is to be used. The field tester shall document which color scheme was used. Examples are given below:



- I. Length Measurement
- The length of each balanced twisted pair shall be recorded.
 - Since physical length is determined from electrical length, the physical length of the link calculated using the pair with the shortest electrical delay shall be reported and used for making the pass or fail determination.

3. The pass or fail criteria is based on the maximum length allowed for the Permanent Link as specified in ANSI/TIA-568.2-E plus the nominal velocity of propagation (NVP) uncertainty of 10%. For a Permanent Link, the length measurement can be 325 ft. (99 m) before a fail is reported.

J. Propagation Delay measurement

1. Is the time it takes for a signal to reach the end of the link.
2. The measurement shall be made at 10 MHz per ANSI/TIA-1152.
3. The propagation delay of each balanced twisted pair shall be recorded.
4. Is not to exceed 498 ns per ANSI/TIA-568.2-E Section 6.3.18.

K. Delay Skew measurement

1. Is the difference in propagation delay @ 10 MHz between the shortest delay and the delays of the other wire pairs.
2. The delay skew of each balanced twisted pair shall be recorded.
3. Is not to exceed 44 ns per ANSI/TIA-568.2-E Section 6.3.19.

L. DC Loop Resistance

1. Often reported as Resistance, is the DC loop resistance of both conductors in the pair.
2. The DC Resistance shall be reported for all four pairs.
3. Is not to exceed 21 Ω for all four pairs per ANSI/TIA-568.2-E Section 6.3.1.

M. DC Resistance Unbalance

1. Often reported as Resistance Unbalance, is the difference in resistance of the two wires within the pair.
2. Is not specified in ANSI/TIA-1152 for a Permanent Link, but shall be reported for all four pairs.

N. DC Resistance Unbalance within a pair

1. Is the difference in DC resistance of the two wires within the same pair.
2. The DC Resistance Unbalance within a pair shall be reported for all four pairs.
3. Is not to exceed 200 m Ω or 3%, whichever is the greatest per ANSI/TIA-568.2-E Section 6.2.2.

O. DC Resistance Unbalance between pairs

1. Is the difference in DC parallel resistance of the conductors of a pair compared to the DC parallel resistance of another pair, given in the formula below:

$$Resistance\_Unbalance_{Between\_pairs} = \left(\frac{|R_{P1} - R_{P2}|}{R_{P1} + R_{P2}} \right) 100\%$$

Where:

R_{P1} is the DC parallel resistance of the conductors of a pair.

R_{P2} is the DC parallel resistance of the conductors of another pair.

2. The DC Resistance Unbalance shall be reported for the following pairs
 - a. 1,2-3,6
 - b. 1,2-4,5
 - c. 1,2-7,8
 - d. 3,6-4,5
 - e. 3,6-7,8
 - f. 4,5-7,8

3. is not to exceed 200 mΩ or 7.5%, whichever is the greatest.

P. Insertion Loss

1. Is the loss of signal strength over the cabling (in dB).
2. The frequency resolution shall be:
 - a. 1 – 31.25 MHz: 150 kHz
 - b. 31.25 – 100 MHz: 250 kHz
 - c. 100 – 250 MHz: 500 kHz
 - d. 250 – 500 MHz: 1000 kHz
3. Both worst case and worst margins shall be reported in one direction for all four pairs.
4. Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).
5. Is not to exceed the Category 6 and 6A Permanent Link limits found in ANSI/TIA-568.2-E Section 6.3.7.

Q. NEXT (Near-End Crosstalk)

1. Is the difference in amplitude (in dB) between a transmitted signal and the crosstalk received on other wire pairs at the same end of the cabling.
2. The frequency resolution shall be:
 - a. 1 – 31.25 MHz: 150 kHz
 - b. 31.25 – 100 MHz: 250 kHz
 - c. 100 – 250 MHz: 500 kHz
 - d. 250 – 500 MHz: 1000 kHz
3. Both worst case and worst margins shall be reported in both directions for the following pair combinations
 - a. 1,2-3,6
 - b. 1,2-4,5
 - c. 1,2-7,8
 - d. 3,6-4,5
 - e. 3,6-7,8
 - f. 4,5-7,8
4. Is not to exceed the Category 6 and 6A Permanent Link limits found in ANSI/TIA-568.2-E 6.3.8.
5. Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).
6. The Time Domain Xtalk data shall be stored for any marginal or failing NEXT results.

R. PS NEXT (Power Sum Near-End Crosstalk)

1. Is the difference (in dB) between the test signal and the crosstalk from the other pairs received at the same end of the cabling.
2. The frequency resolution shall be:
 - a. 1 – 31.25 MHz: 150 kHz
 - b. 31.25 – 100 MHz: 250 kHz
 - c. 100 – 250 MHz: 500 kHz
 - d. 250 – 500 MHz: 1000 kHz

3. Both worst case and worst margins shall be reported in both directions for all four pairs.
4. Is not to exceed the Category 6 and 6A Permanent Link limits found in ANSI/TIA-568.2-E Section 6.3.9.
5. Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).
6. The Time Domain Xtalk data shall be stored for any marginal or failing PS NEXT results.

S. ACR-N (Attenuation Crosstalk Ratio Near-End)

1. Is a calculation of NEXT minus Insertion Loss of the disturbed pair in dB.
2. The frequency resolution shall be:
 - a. 1 – 31.25 MHz: 150 kHz
 - b. 31.25 – 100 MHz: 250 kHz
 - c. 100 – 250 MHz: 500 kHz
 - d. 250 – 500 MHz: 1000 kHz
3. Both worst case and worst margins shall be reported in both directions for the following pairs
 - a. 1,2-3,6
 - b. 1,2-4,5
 - c. 1,2-7,8
 - d. 3,6-4,5
 - e. 3,6-7,8
 - f. 4,5-7,8
4. Although not specified in ANSI/TIA-568.2-E, it shall be recorded for all twelve possible combinations.

T. PS ACR-N (Power Sum Attenuation Crosstalk Ratio Near-End)

1. Is a calculation of PS NEXT minus Insertion Loss of the disturbed pair in dB.
2. The frequency resolution shall be:
 - a. 1 – 31.25 MHz: 150 kHz
 - b. 31.25 – 100 MHz: 250 kHz
 - c. 100 – 250 MHz: 500 kHz
 - d. 250 – 500 MHz: 1000 kHz
3. Both worst case and worst margins shall be reported in both directions for all four pairs.
4. Although not specified in ANSI/TIA-568.2-E, it shall be recorded for all eight possible combinations.

U. ACR-F (Attenuation Crosstalk Ratio Far-End)

1. Is a calculation of FEXT minus Insertion Loss of the disturbed pair in dB.
2. The frequency resolution shall be:
 - a. 1 – 31.25 MHz: 150 kHz
 - b. 31.25 – 100 MHz: 250 kHz
 - c. 100 – 250 MHz: 500 kHz
 - d. 250 – 500 MHz: 1000 kHz

3. Both worst case and worst margins shall be reported in both directions for the following pairs
 - a. 1,2-3,6
 - b. 1,2-4,5
 - c. 1,2-7,8
 - d. 3,6-1,2
 - e. 3,6-4,5
 - f. 3,6-7,8
 - g. 4,5-1,2
 - h. 4,5-3,6
 - i. 4,5-7,8
 - j. 7,8-1,2
 - k. 7,8-3,6
 - l. 7,8-4,5

4. Is not to exceed the Category 6 and 6A Permanent Link limits found in ANSI/TIA-568.2-E Section 6.3.11.
5. Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).

V. PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End)

1. Is a calculation of PS FEXT minus Insertion Loss of the disturbed pair in dB.
2. The frequency resolution shall be:
 - a. 1 – 31.25 MHz: 150 kHz
 - b. 31.25 – 100 MHz: 250 kHz
 - c. 100 – 250 MHz: 500 kHz
 - d. 250 – 500 MHz: 1000 kHz
3. Both worst case and worst margins shall be reported in both directions for all four pairs.
4. Is not to exceed the Category 6 and 6A Permanent Link limits found in ANSI/TIA-568.2-E Section 6.3.13.
5. Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).

W. Return Loss

1. Is the difference (in dB) between the power of a transmitted signal and the power of the signals reflected back.
2. The frequency resolution shall be:
 - a. 1 – 31.25 MHz: 150 kHz
 - b. 31.25 – 100 MHz: 250 kHz
 - c. 100 – 250 MHz: 500 kHz
 - d. 250 – 500 MHz: 1000 kHz
3. Both worst case and worst margins shall be reported in both directions for all four pairs.
4. Shall be ignored at all frequencies where the Insertion Loss is less than 3 dB for that pair.
5. Is not to exceed the Category 6 and 6A Permanent Link limits found in ANSI/TIA-568.2-E Section 6.3.6.
6. Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).

7. The Time Domain Reflectometer data shall be stored for any marginal or failing Return Loss results.
- X. TCL (Transverse Conversion Loss)
1. Is the ratio (in dB) between a differential mode signal inject at the near-end and the common-mode signal measured at the near-end on the same wire pair.
 2. The frequency resolution shall be:
 - a. 1 – 31.25 MHz: 150 kHz
 - b. 31.25 – 100 MHz: 250 kHz
 - c. 100 – 250 MHz: 500 kHz
 - d. 250 – 500 MHz: 1000 kHz
 3. Both worst case and worst margins shall be reported in both directions for all four pairs.
 4. Is not to exceed the Category 6 and 6A limits found ANSI/TIA-568.2-E Section 6.2.14.
- Y. ELTCTL (Equal Level Transverse Conversion Transfer Loss)
1. Is the ratio (in dB) between a differential mode signal inject at the near-end and the common-mode signal measured at the far end on the same wire pair minus the Insertion Loss of that pair.
 2. The frequency resolution shall be:
 - a. 1 – 31.25 MHz: 150 kHz
 - b. 31.25 – 100 MHz: 250 kHz
 - c. 100 – 250 MHz: 500 kHz
 - d. 250 – 500 MHz: 1000 kHz
 3. Both worst case and worst margins shall be reported in both directions for all four pairs.
 4. Is not to exceed the Category 6 and 6A limits found in ANSI/TIA-568.2-E section 6.2.16.
- Z. PS ANEXT (Power Sum Alien Near-End Crosstalk)
1. Takes into account the combined alien crosstalk (statistical) on a receive pair from all external near-end disturbers operating simultaneously.
 2. The frequency resolution shall be:
 - a. 1 – 31.25 MHz: 150 kHz
 - b. 31.25 – 100 MHz: 250 kHz
 - c. 100 – 250 MHz: 500 kHz
 - d. 250 – 500 MHz: 1000 kHz
 3. The disturbed (victim) link shall have disturber links to the left and right of it and if present, links above and below it.
 4. Disturber cables shall include all links within the same bundle as the disturbed (victim) link and adjacent links
 5. Should be measured in both directions if the link is patch panel to patch panel. If the link is patch panel to telecommunications outlet, then it shall be measured from the patch panel end only.
 6. Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568.2-E Section 6.3.21.

AA. Average PS ANEXT (Power Sum Alien Near-End Crosstalk)

1. Is calculated by averaging the individual PSANEXT loss values, in dB, for all four pairs in the disturbed (victim) link.
2. The frequency resolution shall be:
 - a. 1 – 31.25 MHz: 150 kHz
 - b. 31.25 – 100 MHz: 250 kHz
 - c. 100 – 250 MHz: 500 kHz
 - d. 250 – 500 MHz: 1000 kHz
3. Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568.2-E Section 6.3.22.

BB. PS AACR-F (Power Sum Alien Attenuation to Crosstalk Ratio Far-End)

1. AFEXT loss is the coupling of crosstalk at the far-end from external link pairs into a disturbed (victim) pair of the 4-pair link under test. PS AACR-F is the calculated power sum from all external pairs into the disturbed (victim) pair.
2. The frequency resolution shall be:
 - a. 1 – 31.25 MHz: 150 kHz
 - b. 31.25 – 100 MHz: 250 kHz
 - c. 100 – 250 MHz: 500 kHz
 - d. 250 – 500 MHz: 1000 kHz
3. The disturbed (victim) link shall have disturber links to the left and right of it and if present, links above and below it.
4. Disturber cables shall include all links within the same bundle as the disturbed (victim) link and adjacent links
5. Should be measured in both directions if the link is patch panel to patch panel. If the link is patch panel to telecommunications outlet, then it shall be measured from the patch panel end only.
6. Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568.2-E Section 6.3.25.

CC. Average PS AACR-F (Power Sum Alien Attenuation to Crosstalk Ratio Far-End)

1. Is calculated by averaging the individual PS AACR-F values, in dB, for all four pairs in the disturbed (victim) link.
2. The frequency resolution shall be:
 - a. 1 – 31.25 MHz: 150 kHz
 - b. 31.25 – 100 MHz: 250 kHz
 - c. 100 – 250 MHz: 500 kHz
 - d. 250 – 500 MHz: 1000 kHz
3. The disturbed (victim) link shall have disturber links to the left and right of it and if present, links above and below it.
4. Disturber cables shall include all links within the same bundle as the disturbed (victim) link and adjacent links
5. Should be measured in both directions if the link is patch panel to patch panel. If the link is patch panel to telecommunications outlet, then it shall be measured from the patch panel end only.

6. Is not to exceed the Category 6A Permanent Link limits found in ANSI/TIA-568.2-E Section 6.3.26.

3.03 ADMINISTRATION - COPPER CABLING

A. Test results documentation

1. Test results saved within the field-test instrument shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of the test records. These test records shall be uploaded to the PC unaltered, i.e., "as saved in the field-test instrument". The file format, CSV (comma separated value), does not provide adequate protection of these records and shall not be used.
2. The test results documentation shall be available for inspection by the Owner or the Owner's representative during the installation period and shall be passed to the Owner's representative within 5 working days of completion of tests on cabling served by a telecommunications room or of backbone cabling. The installer shall retain a copy to aid preparation of as-built information.
3. The database for the complete project, including twisted-pair copper cabling and fiber links, if applicable, shall be stored and delivered on CD or DVD prior to Owner acceptance of the building. This CD or DVD shall include the software tools required to view, inspect, and print any selection of the test reports.
4. Circuit IDs reported by the test instrument should match the specified label ID.
5. For Permanent Link testing, the detailed test results documentation data is to be provided in an electronic database for each tested balance twisted-pair and shall contain the following information
 - a. The overall Pass/Fail evaluation of the link-under-test
 - b. The date and time the test results were saved in the memory of the tester
 - c. The identification of the customer site as specified by the end-user
 - d. The name of the test limit selected to execute the stored test results
 - e. The name of the personnel performing the test
 - f. The version of the test firmware and the version of the test limit database held within the test instrument
 - g. The manufacturer, model and serial number of the field-test instrument
 - h. The adapters used
 - i. The factory calibration date
 - j. Wire Map
 - k. Propagation Delay values, for all four pairs
 - l. Delay Skew values, for all four pairs
 - m. DC Resistance values, for all four pairs
 - n. DC Resistance Unbalance within a pair, values for all four pairs
 - o. DC Resistance Unbalance between pairs, values for all four pairs
 - p. Insertion Loss, worst case values for all four pairs
 - q. NEXT, worst case margin and worst case values, both directions
 - r. PS NEXT, worst case margin and worst case values, both directions
 - s. ACR-N, worst case margin and worst case values, both directions
 - t. PS ACR-N, worst case margin and worst case values, both directions
 - u. ACR-F, worst case margin and worst case values, both directions
 - v. PS ACR-F, worst case margin and worst case values, both directions
 - w. Return Loss, worst case margin and worst case values, both directions
 - x. TCL, worst case margin and worst case values, both directions
 - y. ELTCTL, worst case margin and worst case values, both directions.
 - z. Time Domain Crosstalk data if the link is marginal or fails
 - aa. Time Domain Reflectometer data if the link is marginal or fails

6. For Alien Crosstalk testing, the detailed test results documentation data is to be provided in AxTalk Analyzer for each tested balance twisted-pair and shall contain the following information
 - a. The overall Pass/Fail evaluation of the link-under-test
 - b. The date and time the measurements were made
 - c. The identification of the customer site as specified by the end-user
 - d. The name of the test limit selected to execute the stored test results
 - e. The name of the personnel performing the test
 - f. The version of the test software
 - g. PS ANEXT, worst case margin for all four pairs
 - h. Average PS ANEXT, worst case margin
 - i. PS AACR-F, worst case margin for all four pairs
 - j. Average PS AACR-F, worst case margin

B. Record copy and as-built drawings - Copper Cabling

1. Provide record copy drawings periodically throughout the project as requested by the Construction Manager or Owner, and at end of the project on a CD or DVD. Record copy drawings at the end of the project shall be in CAD format and include notations reflecting the as built conditions of any additions to or variation from the drawings provided such as, but not limited to cable paths and termination point. The as-built drawings shall include, but are not limited to block diagrams, frame and cable labeling, cable termination points, equipment room layouts and frame installation details. The as-builts shall include all field changes made up to construction completion:
 - a. Field directed changes to pull schedule.
 - b. Horizontal cable routing changes.
 - c. Associated detail drawings.

3.04 IDENTIFICATION

A. Labeling

1. Labeling shall conform to the requirements specified within ANSI/TIA-606-D or to the requirements specified by the Owner or the Owner's representative.

3.05 REPAIR

- A.** Any connections failing to meet referenced standards or more stringent performance requirements stated above, must be removed and replaced with connections that prove, in additional testing, to meet or exceed the performance standards set forth.

3.06 RE-INSTALLATION

- A.** No additional burden to the owner regarding costs, network down-time and/or end user interruption shall result from the re-installation of specified components. Scheduling for re-installation work shall be coordinated, in writing, with the owner prior to beginning the work.

3.07 CLOSEOUT ACTIVITIES

- A.** Contractor to submit all test results and any test documentation required prior to acceptance by the Owner.
- B.** Record copy and as-built drawings
- C.** Provide record copy drawings periodically throughout the project as requested by the Construction Manager or Owner, and at end of the project on CD-ROM. Record copy drawings

at the end of the project shall be in CAD format and include notations reflecting the as built conditions of any additions to or variation from the drawings provided such as, but not limited to cable paths and termination point. CAD drawings are to incorporate test data imported from the test instruments.

- D. The as-built drawings shall include, but are not limited to block diagrams, frame and cable labeling, cable termination points, equipment room layouts and frame installation details. The as-builts shall include all field changes made up to construction completion:
1. Field directed changes to pull schedule.
 2. Field directed changes to cross connect and patching schedule.
 3. Horizontal cable routing changes.
 4. Backbone cable routing or location changes.
 5. Associated detail drawings.

3.08 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.
- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.
- C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the startup procedure.
- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Access control system.

B. Related Requirements:

1. Section 280010 "Supplemental Requirements for Electronic Safety and Security" specifies additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 013100 "Project Management and Coordination" specifies preinstallation conference procedures.
3. Section 087100 "Door Hardware" specifies the following:
 - a. Electric strike(s).
 - b. Electromagnetic lock(s).
 - c. Delayed-egress electromagnetic lock(s).
 - d. Electromechanical lock(s).
 - e. Self-contained electronic lock(s).
 - f. Exit lock(s) and alarm(s).
 - g. Auxiliary electrified door hardware.
4. Section 281300 "Access Control Software and Database Management" specifies the following:
 - a. Access control system unit operating system software.
 - b. Access control system unit antivirus and security protection software.
 - c. Visitor management database software.
 - d. Mobile credential validation database software.
 - e. Access control system supplementary computer equipment operating system software.
 - f. Access control system supplementary computer equipment antivirus and security protection software.
 - g. Credential card personalization software.
 - h. Credential card printer and encoder software.
5. Section 281400 "Access Control System Hardware" specifies the following:
 - a. Access control system server(s).
 - b. Access control system DGP(s).
 - c. Access control system door controller(s).
 - d. Access control system input/output interface(s).
 - e. Access control system power supply and battery charger(s).
6. Section 281500 "Integrated Access Control Hardware Devices" specifies the following:
 - a. Proximity reader(s) for card, fob, or smartphone.
 - b. Access control cards.
 - c. REX motion sensor(s).
 - d. REX push-button(s).

- e. Door position switch(es)
 - f. Magnetic lock hardware with special locking arrangement for fire-rated door(s).
- 7. Section 281523 "Intercom Entry Systems" specifies the following:
 - a. Digital audio intercom entry system(s).
 - b. Digital audio-video intercom entry system(s).
- 8. Section 282000 "Video Surveillance" specifies the following:
 - a. IP Video surveillance camera and recording equipment.

C. [Section 019113 – General Commissioning Requirements.](#)

1.02 DEFINITIONS

- A. DGP: Data gathering panel.
- B. NFC: Near field communications.
- C. REX: Request-to-exit.

1.03 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
- B. Preinstallation Coordination Meeting(s): For access control. Conduct meeting(s) at Project site before cabling infrastructure rough-in.
 - 1. Attendees: Installers, fabricators, representatives of manufacturers, and administrators for field tests and inspections. Notify Architect, Construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.

1.04 ACTION SUBMITTALS

- A. Shop Drawings:
 - 1. Project general notes.
 - 2. Head-end hardware, equipment, and device locations.
 - 3. Block diagram and cable/conduit routing illustrating end-to-end system wiring.
 - 4. End-to-end system communications details.
 - 5. Secondary power calculations
- B. Field quality-control reports.

1.05 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.06 CLOSEOUT SUBMITTALS

- A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:
 - 1. Installation and programming instructions for operating system software, including all applicable software add-ons.
 - 2. Installation and programming instructions for antivirus and security protection software.
 - 3. Manufacturer's recommended setup and testing procedure for operating system software and applicable software add-ons.

4. Troubleshooting instructions for operating system software and applicable software add-ons.
5. Manufacturer's recommended setup and testing procedure for antivirus and security protection software.
6. Troubleshooting instructions for antivirus and security protection software.
7. Installation instructions for access control system servers.
8. Installation instructions for access control system DGPs.
9. Installation instructions for access control system input/output interface.
10. Installation instructions for access control system door controllers.
11. Installation instructions for access control system power supplies and battery chargers.
12. Manufacturer's recommended testing and inspection procedure for operation of access control system servers, panels, input/output interfaces, door controllers, and workstations.
13. Manufacturer's recommended testing and inspection procedure for operation of access control system power supplies and battery chargers.
14. Installation instructions for integrated credential readers and entry management devices.
15. Printing, programming, and handling instructions for access control credentials.
16. Installation instructions for electrified locking devices and accessories.
17. Installation instructions for egress management devices.
18. Installation instructions for access control remote devices.
19. Installation instructions for telephone entry systems.
20. Installation instructions for intercom entry systems.
21. Installation instructions for electronic key management systems.
22. Installation instructions for access control electronic turnstiles and mobility systems.
23. Manufacturer's recommended tests and inspections for integrated credential readers and entry management devices.
24. Manufacturer's recommended tests and inspections for electrified locking devices and accessories.
25. Manufacturer's recommended tests and inspections for egress management devices.
26. Manufacturer's recommended tests and inspections for telephone entry systems.
27. Manufacturer's recommended tests and inspections for intercom entry systems.
28. Manufacturer's recommended testing and inspection procedure for end-to-end operation of access control system software, hardware, and integrated hardware devices.

B. Warranty documentation.

1.07 WARRANTY FOR ACCESS CONTROL SYSTEM

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed access control system performs in accordance with specified requirements and agrees to repair or replace components that fail to perform as specified within extended-warranty period.
1. Extended-Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.
- B. Special Manufacturer Extended Warranty: Manufacturer warrants that components of access control system perform in accordance with specified requirements and agrees to provide repair or replacement of components that fail to perform as specified within extended-warranty period.
1. Initial Extended-Warranty Period: Five years from date of Substantial Completion; full coverage for labor, materials, and equipment.
 2. Follow-On Extended-Warranty Period: Eight years from date of Substantial Completion; prorated coverage for components only, free on board destination, freight prepaid.

1.08 WARRANTY FOR BATTERIES

- A. Special Manufacturer Extended Warranty for Batteries: Manufacturer warrants that batteries perform in accordance with specified requirements and agrees to provide repair or replacement of batteries that fail to perform as specified within warranted cycle life.
 - 1. Initial Extended-Warranty Period for Li-ion Batteries: Three years from date of Substantial Completion; full coverage for materials only, free on board, freight prepaid.
 - 2. Follow-On Extended-Warranty Period for Li-ion Batteries: Ten years from date of Substantial Completion; prorated coverage for materials only, free on board destination, freight prepaid.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 INSTALLATION OF ACCESS CONTROL SYSTEM

- A. Description: Access control system provides a means of regulating or controlling physical entry into an area, or access to or use of a device by electrical, electronic, and/or mechanical means. Typical access control system includes a card reader at a controlled door, which reads a user credential and sends the collected data to a centrally located DGP over the cabling infrastructure. DGP may hold a user database onboard or may communicate with a user database over the network. If user is authorized for access at a controlled door, DGP signals the electronic lock at the door to unlock. If user credential is not authorized according to user database, the door remains locked and access is denied. In addition to card readers and electronic locks, access control systems may include various other connected devices programmed for a desired function.
- B. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Components listed and labeled in accordance with NFPA 70 and NFPA 72, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - b. Comply with NFPA 1, NFPA 730, NFPA 731, and ICC IBC.
 - c. Certification: Provide certificate, authorized under UL Certification Service, that access control system installation complies with installation requirements of UL CCN ALOV.
 - 2. Listing Criteria: UL CCN ALOV and UL CCN ALVY; including UL 294.
 - 3. Consult Architect for resolution of conflicting requirements.
- C. Selection of Access Control System Components:
 - 1. Source Limitations: Obtain components for access control system from sources approved by manufacturer warranting performance of entire system.
 - 2. Provide the following specified products with the access control system:
 - a. Access Control Software and Database Management:
 - 1) Access control system unit operating system software.
 - 2) Access control system unit antivirus and security protection software.

- 3) Visitor management database software.
 - 4) Mobile credential validation database software.
 - 5) Access control system supplementary computer equipment operating system software.
 - 6) Access control system supplementary computer equipment antivirus and security protection software.
 - 7) Credential card personalization software.
 - 8) Credential card printer and encoder software.
 - b. Access Control System Hardware:
 - 1) Quantity as indicated on Drawings of access control system server(s).
 - 2) Quantity as indicated on Drawings of access control system DGP(s).
 - 3) Quantity as indicated on Drawings of access control system door controller(s).
 - 4) Quantity as indicated on Drawings of access control system input/output interface(s).
 - 5) Quantity as indicated on Drawings of access control system power supply and battery charger(s).
 - c. Access Control Credentials:
 - 1) Furnish (25) access control cards to Owner.
 - d. Electrified Locking Devices and Accessories:
 - 1) Quantity as indicated on Drawings of REX motion sensor(s).
 - 2) Quantity as indicated on Drawings of REX push-button(s).
 - e. Egress Management Devices:
 - 1) Quantity as indicated on Drawings of magnetic lock hardware.
 - f. Intercom Entry Systems:
 - 1) Quantity as indicated on Drawings of digital audio-video intercom entry system(s).
 3. Operation:
 - a. Exchange database information directly with DGPs.
- D. Special Techniques:
1. Comply with manufacturer's published instructions.
 2. Mounting Heights: Mount field devices in accessible locations in accordance with United States Access Board ADA-ABA Accessibility Guidelines standards.
 3. Wiring Methods:
 - a. Backbone Cable Type: copper.
 - b. Cable Type: Unshielded.
 - c. Analog Maximum Cable Length: 1000 ft.
 - d. Digital Maximum Cable Length: 300 ft.

E. Interfaces with Other Work:

1. Coordinate with Section 284700 "Mass Notification" for unlocking secured doors that are in exit ways, with or without delay.
2. Coordinate with Section 285211 "Detention Monitoring and Control Systems" for interfacing access control system with detention monitoring and controls.
3. Coordinate with Section 323113 "Chain Link Fences and Gates" for interfacing access control system with fence and gate controls.

F. Systems Integration:

1. Coordinate with Section 282000 "Video Surveillance" for integrating access control system with video surveillance controls.

3.02 FIELD QUALITY CONTROL OF ACCESS CONTROL SYSTEM COMPONENTS

A. Tests and Inspections:

1. Perform manufacturer's recommended tests and inspections for access control system components.
2. Perform industry standard tests and inspections for power supplies, batteries, and other standby power provisions.
3. Verify monitoring of access control system status and diagnostics information.

B. Nonconforming Work:

1. Access control equipment will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Collect, assemble, and submit test and inspection reports.

3.03 SYSTEM STARTUP

1. Complete installation and startup checks in accordance with manufacturer's published instructions.

3.04 ADJUSTING

A. Control Sensor Adjustments: Adjust control devices to suit actual occupied conditions.

1. For proximity motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

3.05 PROTECTION

A. After installation, protect access control system components from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

3.06 MAINTENANCE

A. Control Sensor Readjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in readjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.07 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.
- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.
- C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the startup procedure.
- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

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.
- B. [Section 019113 – General Commissioning Requirements.](#)

1.02 SUMMARY

- A. Section Includes:
 - 1. Integrated credential readers and entry management.
 - 2. Electrified locking devices and accessories.
- B. Related Requirements:
 - 1. Section 281300 "Access Control System Software and Database Management" for control and monitoring applications, workstations, and interfaces.
 - 2. Section 281523 "Intercom Entry Systems" for access control intercom entry products.

1.03 DEFINITIONS

- A. Credential: Data assigned to an entity and used to identify that entity.
- B. DTS: Digital Termination Service. A microwave-based, line-of-sight communication provided directly to the end user.
- C. Identifier: A credential card; keypad personal identification number; or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.
- D. Location: A Location on the network having a PC-to-controller communications link, with additional controllers at the Location connected to the PC-to-controller link with a TIA 485-A communications loop. Where this term is presented with an initial capital letter, this definition applies.
- E. PC: Personal computer. Applies to the central station, workstations, and file servers.
- F. RAS: Remote access services.
- G. RF: Radio frequency.
- H. ROM: Read-only memory. ROM data are maintained through losses of power.
- I. TCP/IP: Transport control protocol/Internet protocol.
- J. TWAIN: Technology without an Interesting Name. A programming interface that lets a graphics application, such as an image editing program or desktop publishing program, activate a scanner, frame grabber, or other image-capturing device.
- K. WMP: Windows media player.
- L. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.

- M. WYSIWYG: What You See Is What You Get. Text and graphics appear on the screen the same as they will in print.

1.04 PREINSTALLATION MEETINGS

- A. Preinstallation Coordination Meeting(s): For integrated access control hardware devices. Conduct meeting(s) at Project site before commencement of cable installation.
 - 1. Attendees: Installers, fabricators, representatives of manufacturers, representatives from telecommunications, Owner's security representatives, IT representatives, and administrators for field tests and inspections. Notify Architect, Construction Manager, and Owner's Commissioning Authority of scheduled meeting dates.

1.05 ACTION SUBMITTALS

- A. Product Data:
 - 1. Integrated Credential Readers and Entry Management:
 - a. Credential readers.
 - 2. Access Control Credentials:
 - a. Access control cards.
 - 3. Electrified Locking Devices and Accessories:
 - a. Status monitoring and egress devices.
- B. Shop Drawings:
 - 1. Project general notes.
 - 2. Device layout.
 - 3. Block diagram and cable/conduit routing.
 - 4. System communications details.
 - 5. System mounting details.
 - 6. Secondary power calculations.
- C. The use of copied Construction Documents or Bid Documents is unacceptable without prior authorization from [Design Consultant] or [The Architect]. Copied documents include but are not limited to; design documents copied to drawings with contractor's title block, scanned copies of documents inserted into the submittals, direct links to the Consultant BIM model, or CAD files.
- D. Submittals and shop drawings that are copied, incomplete, or which contain insufficient information will be returned without review, for resubmittal
- E. Field quality-control reports.
 - 1. Field quality-control reports.

1.06 INFORMATIONAL SUBMITTALS

- A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:
 - 1. Installation instructions for integrated credential readers and entry management devices.

2. Manufacturer's recommended tests and inspections for integrated credential readers and entry management devices.
3. Printing, programming, and handling instructions for access control credentials.
4. Installation instructions for egress management devices.
5. Manufacturer's recommended tests and inspections for egress management devices.

B. Sample warranties.

1.07 CLOSEOUT SUBMITTALS

A. Maintenance Contracts:

1. Software and firmware service agreements.

B. Warranty documentation.

1.08 WARRANTY

A. Integrated Credential Readers and Entry Management Devices Warranty:

1. Special Installer Extended Warranty: Installer warrants that fabricated and installed integrated credential readers and entry management devices perform in accordance with specified requirements and agrees to repair or replace components that fail to perform as specified within extended-warranty period.
 - a. Extended-Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

B. Electrified Locking Devices and Accessories Warranty:

1. Special Installer Extended Warranty: Installer warrants that fabricated and installed electrified locking devices and accessories perform in accordance with specified requirements and agrees to repair or replace components that fail to perform as specified within extended-warranty period.
 - a. Extended-Warranty Period: Three years from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.01 INTEGRATED CREDENTIAL READERS AND ENTRY MANAGEMENT

A. Proximity Reader for Card, Fob, or Smartphone:

1. Products: Subject to compliance with requirements, provide the following:
 - a. HID Global; ASSA ABLOY; RP40 multiCLASS SE 13.56 MHz contactless readers for standard wall-mount locations; RP10 mini-mullion reader for mullion-mounted locations.
2. Source Limitations: Obtain products from single manufacturer.
3. Performance Criteria:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.

- b. Listing Criteria:
 - 1) UL CCN ALVY; including UL 294.
 - 2) Plastic Enclosure: UL CCN QMFZ2; including UL 94.
 - c. General Characteristics: Visual LED indication of card read.
4. Options:
- a. Enclosure Rating: IEC 60529, IP55.
 - b. Input Voltage: 5 to 16 V(dc).
 - c. Operating Temperature: Minus 40 to plus 160 deg F.
 - d. Read Range: Up to 1 inch.
 - e. Transmit Frequency: 13.56 MHz.
 - f. Materials: Polycarbonate.
 - g. Colors: Black.
 - h. Climate: Indoor and outdoor.
 - i. Size: Single gang.
5. Accessories:
- a. Long-range receiver module.

2.02 ACCESS CONTROL CREDENTIALS

A. Access Control Cards

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. HID Global; ASSA ABLOY.
- 2. Performance Criteria:
 - a. Reference Standards:
 - 1) Personal Identity Verification (PIV): FIPS PUB 201-2.
 - 2) Physical: IEC 7810; IEC 10373; IEC 7816 for contact cards; and IEC 14443 for contactless cards.
 - 3) Functional: UL 294; IEC 60839-11-1; and IEC 60839-11-2.
 - 4) Material Durability: INCITS 322.
 - b. Format: Customizable, including artwork.
 - 1) On Front: Photograph, full name (surname first), affiliation, organization, card expiration date, color-coding, Owner's name, Owner's logo, two-dimensional bar code.
 - 2) On Back: Physical characteristics of cardholder, employee ID number, card number, magnetic stripe, linear bar code, return address.
 - 3) Stored Data Elements: PIN, employee ID number, two fingerprint templates, electronic facial image, one iris image, digital signature private key and certificate, key management private key and certificate, card authenticate data, and PIV authentication data.

3. Options:
 - a. Data Format: Wiegand 26 bit.
 - b. Transmit Frequency: 125 kHz and 13.56 MHz.
 - c. Data Retention: 10 years.
 - d. Memory Capacity: 8 kB.
 - e. Operating Temperature: Minus 40 to plus 185 deg F.
 - f. Materials: Plastic.
 - g. Color: White.
 - h. Reading Medium: Proximity and chip and magnetic strip.

2.03 ELECTRIFIED LOCKING DEVICES AND ACCESSORIES

A. Request-to-Exit (REX) Motion Sensor:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASSA ABLOY Electronic Security Hardware; ASSA ABLOY.
 - b. Bosch
 - c. Honeywell Commercial Security; Honeywell International, Inc.
2. Source Limitations: Obtain products from single manufacturer.
3. Performance Criteria:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
 - b. Listing Criteria: UL CCN ALVY; including UL 294.
4. Options:
 - a. Input Power: 125 V(ac).
 - b. Operating Temperature: Minus 13 to plus 140 deg F.
 - c. Sensing Technology: Passive infrared (PIR).
 - d. Color: Black.
 - e. Mounting: Wall surface.

B. Request-to-Exit (REX) Push Button:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ASSA ABLOY Electronic Security Hardware; ASSA ABLOY.
 - b. Dortronics.
 - c. Schlage; an Allegion brand.
 - d. Von Duprin; Allegion plc.
2. Source Limitations: Obtain products from single manufacturer.
3. Performance Criteria:
 - a. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.
 - b. Listing Criteria: UL CCN ALVY; including UL 294.

- 4. Options:
 - a. Input Power: 12 to 24 V(ac/dc).
 - b. Operating Temperature: Minus 13 to plus 140 deg F.
 - c. Operating Mechanism: Pneumatic.
 - d. Faceplate Material: Stainless steel.
 - e. Button Material: Plastic.
 - f. Button Color: Green.
 - g. Lettering Color: White.
 - h. Failure Mode: Fail-safe.

C. Door Position Switch

- 1. Basis of Design Subject to compliance with requirements, provide GRI; 195-12 or a comparable product by one of the following:
 - a. Allegion
 - b. Securitron ASSA ABLOY Electronic Security Hardware; ASSA ABLOY.
 - c. Locknetics
- 2. Description: Balanced-magnetic switch, complying with UL 634, installed on frame with integral overcurrent device to limit current to 80 percent of switch capacity. Bias magnet and minimum of three encapsulated reed switches shall resist compromise from introduction of foreign magnetic fields.
- 3. Flush-Mounted Switches: Unobtrusive and flush with surface of door and window frame.
- 4. Overhead Door Switch: Balanced-magnetic type, listed for outdoor locations, and having door-mounted magnet and floor-mounted switch unit.
- 5. Remote Test: Simulate movement of actuating magnet from master control unit.
- 6. Double-pole double throw switches for integration with the intrusion detection system.

D. Panic/Lockdown Button

- 1. Basis of Design: Subject to compliance with requirements, provide Camden Door Control; CM-4085RPTE or a comparable product by one of the following:
 - a. Allegion
 - b. Dortronics
 - c. Securitron ASSA ABLOY Electronic Security Hardware; ASSA ABLOY.
 - d. Locknetics
- 2. Illuminated piezo push switch
- 3. Single gang & narrow faceplates
- 4. Red and/or green illumination
- 5. Fail safe/ fail secure selectable
- 6. N/o + n/c outputs
- 7. Integrated 40 second adjustable timer
- 8. 12/24 vdc
- 9. Rugged stainless steel faceplates
- 10. Available with various logos, words, languages
- 11. Tied to intrusion system, FA system and gunshot system
- 12. Depressing a lockdown button initiates the following procedures:
 - a. Locking specific entrance doors – coordinate locations with Owner
 - b. Initiation of public address/paging system speaker announcements, clock system digital messaging, and text messaging school administrative staff – coordinate with

- requirements of Section 275313 "Intercommunications, Paging and Clock Systems". Coordinate all system programming requirements with Owner.
- c. Initiation of a duress alarm sent to Warwick Police Dispatch that there is an emergency requiring Police intervention. Coordinate all system programming requirements with Owner.
- d. Initiation of visual signals through PA/Intercom/Clock System.

- 13. Coordinate all lockdown system requirements with Owner.

PART 3 - EXECUTION

3.01 DEPLOYMENT OF CREDENTIALS

- A. Comply with manufacturer's published instructions.

3.02 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Special Techniques:
 - 1. Cable Type: Shielded.
 - 2. Analog Maximum Cable Length: 1000 ft.
 - 3. Digital Maximum Cable Length: 300 ft.
- C. Composite Cable
 - 1. Contractor shall furnish and install one (1) composite cable at each access-controlled door, in lieu of separate cables described above.
 - 2. Composite cable shall contain individual cables bundled under an overall plenum-rated jacket, serving the following devices:
 - a. Lock Power
 - b. Card Reader
 - c. Door Contact
 - d. Request-to-Exit device
 - e. Manufacturer: Superior Essex Part No. CMP/CL3P AC-A1x-68.
- D. Interfaces with Other Work:
 - 1. Coordinate installation of new products for access control hardware devices with existing conditions.
 - 2. Coordinate access control credentials with integrated credential readers and access control system architecture.
 - 3. Egress Management Interfaces:
 - a. Coordinate with Section 282000 "Video Surveillance" for automatic video feed callup upon delayed egress activation.
 - b. Coordinate with Section 230923 "Direct Digital Control (DDC) System for HVAC" for monitoring of egress management device alarms by BMS.

3.03 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Perform manufacturer's recommended tests and inspections.

- B. Nonconforming Work:
 - 1. Device will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- C. Collect, assemble, and submit test and inspection reports.
- D. Manufacturer Services:
 - 1. Engage factory-authorized service representative to support field tests and inspections.

3.04 PROTECTION

- A. After installation, protect integrated access control hardware devices from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

3.05 MAINTENANCE

- A. Software and Firmware Service Agreement:
 - 1. Technical Support: Beginning at Substantial Completion, verify that software and firmware service agreement includes software and firmware support for two years.
 - 2. Upgrade Service: At Substantial Completion, update software and firmware to latest version. Install and program software and firmware upgrades that become available within two years from date of Substantial Completion.
 - a. Upgrade Notice: No fewer than 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.
 - 3. Upgrade Reports: Prepare report after each update, documenting upgrades installed.

3.06 COMMISSIONING

- A. Where indicated in the equipment or commissioning specifications, engage a factory-authorized service representative, to perform startup service as per functional test sheets and requirements of Section 019113 – General Commissioning Requirements.
- B. Complete installation and startup checks and functional tests according to Section 019113 – General Commissioning Requirements and manufacturers written instructions.
- C. Operational Test: After electrical system has been energized, start units to confirm proper unit operation. Rectify malfunctions, replace defective parts with new one and repeat the startup procedure.
- D. Verify that equipment is installed and commissioned as per requirements of section 019113 and manufacturers written instructions/requirements.

END OF SECTION

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. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Carbon monoxide detectors.
 - 5. Heat detectors.
 - 6. Notification appliances.
 - 7. Magnetic door holders.
 - 8. Integration gateway.
 - 9. Addressable interface device.
 - 10. Digital alarm communicator transmitter.

1.03 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.04 SYSTEM DESCRIPTION

- A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.05 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.06 SUBMITTALS

- A. General Submittal Requirements:
 - 1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
 - 2. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire-alarm system design.
 - b. NICET-certified fire-alarm technician, Level II minimum.
 - c. Licensed or certified by authorities having jurisdiction.
- B. Product Data: For each type of product indicated.

- C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 - 2. Include voltage drop calculations for notification appliance circuits.
 - 3. Include battery-size calculations.
 - 4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - 5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
 - 6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 - 7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
- D. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
 - 2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.
- E. Qualification Data: For qualified Installer.
- F. Seismic Qualification Certificates: For fire-alarm control unit, 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.
- G. Field quality-control reports.
- H. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 - 3. Record copy of site-specific software.
 - 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
 - a. Frequency of testing of installed components.

- b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
- 5. Manufacturer's required maintenance related to system warranty requirements.
- 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
- 7. Copy of NFPA 25.
- I. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.
- C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
- D. 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.
- E. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.08 PROJECT CONDITIONS

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

1.09 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.10 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - 2. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - 3. Keys and Tools: 1 extra set for access to locked and tamper proofed components.
 - 4. Audible and Visual Notification Appliances: 1 of each type installed.
 - 5. Fuses: 2 of each type installed in the system.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings as manufactured by Honeywell Fire-Lite or comparable product by one of the following manufacturers in the next paragraph.
- B. Manufacturers: Subject to compliance with performance and site condition requirements, one of the manufacturers listed below may be provided in lieu of the Basis of Design manufacturer. Naming these products does not imply that their standard construction or configuration is acceptable or meets the specifications. Alternate equipment proposed must meet the specifications including all architectural, acoustic, mechanical, electrical, and structural details, all scheduled performance and the job design, plans and specifications, and space constraints.
 - 1. Honeywell Silent Knight.
 - 2. Honeywell Notifier.

2.02 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors.
 - 4. Verified automatic alarm operation of smoke detectors.
 - 5. Automatic sprinkler system water flow.
 - 6. Fire-extinguishing system operation.
- B. Fire-alarm signal shall initiate the following actions:
 - 1. Continuously operate alarm notification appliances.
 - 2. Identify alarm at fire-alarm control unit.
 - 3. Transmit an alarm signal to the remote alarm receiving station.
 - 4. Unlock electric door locks in designated egress paths.
 - 5. Release fire and smoke doors held open by magnetic door holders.
 - 6. Activate voice/alarm communication system.
 - 7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 - 8. Activate lighting controls.
 - 9. Activate emergency shutoffs for gas and fuel supplies.
 - 10. Record events in the system memory.

- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
 - 1. Valve supervisory switch.
 - 2. Low-air-pressure switch of a dry-pipe sprinkler system.
 - 3. Carbon monoxide detector.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
 - 1. Open circuits, shorts, and grounds in designated circuits.
 - 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 - 3. Loss of primary power at fire-alarm control unit.
 - 4. Ground or a single break in fire-alarm control unit internal circuits.
 - 5. Abnormal ac voltage at fire-alarm control unit.
 - 6. Break in standby battery circuitry.
 - 7. Failure of battery charging.
 - 8. Abnormal position of any switch at fire-alarm control unit or annunciator.
- E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit.

2.03 FIRE-ALARM CONTROL UNIT

- A. General Requirements for Fire-Alarm Control Unit:
 - 1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
 - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder.
 - 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 - 3. Addressable control circuits for operation of mechanical equipment.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 - 1. Annunciator and Display: Liquid-crystal type, 2 line(s) of 40 characters, minimum.
 - 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits:

1. Initiating Device, Notification Appliance, and Signaling Line Circuits:

- a. Initiating Device Circuits: NFPA 72, Class A.
- b. Notification Appliance Circuits: NFPA 72, Class B.
- c. Signaling Line Circuits: NFPA 72, Class A.
- d. Install fault circuit isolators to comply with circuit performance requirements of NFPA 72 or with manufacturer's written instructions, whichever is more conservative.

D. Notification Appliance Circuit: Operation shall sound in a code 3 temporal pattern.

E. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

F. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory.

G. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

H. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.

1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.

- a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
- b. Programmable tone and message sequence selection.
- c. Standard digitally recorded messages for "Evacuation" and "All Clear."
- d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.

2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.

3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

- J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 - 1. Batteries: Sealed lead calcium.
- K. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.04 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
 - 1. Double-action mechanism requiring two actions to initiate an alarm, type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 2. Station Reset: Key- or wrench-operated switch.
 - 3. Integral Addressable Module: Arranged to communicate pull station status to fire-alarm control unit.
 - 4. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
 - 5. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.05 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 - 1. Comply with UL 268; operating at 24-V dc, nominal.
 - 2. Detectors shall be two-wire type.
 - 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 - 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 - 5. Non self-Restoring: Detectors do require resetting or readjustment after actuation to restore them to normal operation.
 - 6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
 - 7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
 - c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

2.06 CARBON MONOXIDE DETECTORS

A. General: Carbon monoxide detector listed for connection to fire-alarm system.

1. Mounting: Adapter plate for outlet box mounting.
2. Testable by introducing test carbon monoxide into the sensing cell.
3. Detector shall provide alarm contacts and trouble contacts.
4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
5. Comply with UL 2075.
6. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
7. Test button simulates an alarm condition.
8. Locate, mount, and wire according to manufacturer's written instructions.

2.07 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.08 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.

B. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.

1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.
2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.

5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red or white as selected by architect.

C. Voice/Tone Notification Appliances:

1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
2. High-Range Units: Rated 2 to 15 W.
3. Low-Range Units: Rated 1 to 2 W.
4. Mounting: Semi-recessed.
5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.09 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting and are complete with matching doorplate.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
3. Rating: 24-V ac or dc. Door hardware voltage shall match.

B. Material, finish and voltage rating: Match door hardware.

2.10 INTEGRATION GATEWAY

A. Description: Interface between fire alarm system and building management system using the BACnet communication protocol. Coordinate with Division 23 for interface requirements and for sequence of operations. Provide all required communication points to Division 23.

2.11 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one telephone line and dial a preset number for a remote central station via the telephone line and radio alarm transmitter. When contact is made with central station(s), signals shall be transmitted. If service on telephone line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the radio alarm transmitter. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both the telephone line and the radio alarm transmitter, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

- D. Digital data transmission shall include the following:
 - 1. Address of the alarm-initiating device.
 - 2. Address of the supervisory signal.
 - 3. Address of the trouble-initiating device.
 - 4. Loss of ac supply or loss of power.
 - 5. Low battery.
 - 6. Abnormal test signal.
 - 7. Communication bus failure.
- E. Secondary Power: Integral rechargeable battery and automatic charger.
- F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.13 RADIO ALARM TRANSMITTER

A. MANUFACTURERS

- 1. [Subject to compliance with requirements, provide product indicated on drawings as manufactured by Kingfisher Company Inc. #STAR-ELT with 8 zone expander board.](#)
- B. Transmitter shall comply with NFPA 1221 and shall be listed and labeled by an NRTL.
- C. Comply with 47 CFR 90.
- D. Description: Manufacturer's standard commercial product; factory assembled, wired, tested, and ready for installation and operation.
 - 1. Packaging: A single, modular, NEMA 250, Type 1 metal enclosure with a tamper-resistant flush tumbler lock.
 - 2. Signal Transmission Mode and Frequency: VHF or UHF 2-W power output, coordinated with operating characteristics of the established remote alarm receiving station designated by Owner.
 - 3. Normal Power Input: 120-V ac.
 - 4. Secondary Power: Integral-sealed, rechargeable, 12-V battery and charger. Comply with NFPA 72 requirements for battery capacity; submit calculations.
 - 5. Antenna Cable: Coaxial cable with impedance matched to the transmitter output impedance.
 - 6. Alarm Interface Devices: Circuit boards, modules, and other auxiliary devices, integral to the transmitter, matching fire-alarm and other system outputs to message-generating inputs of the transmitter that produce required message transmissions.
- E. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit or from its own internal sensors or controls and shall automatically transmit signal along with a unique code that identifies the transmitting station to the remote alarm receiving station. Transmitted messages shall correspond to standard designations for fire-reporting system to which the signal is being transmitted and shall include separately designated messages in response to the following events or conditions:
 - 1. Transmitter Low-Battery Condition: Sent when battery voltage is below 85 percent of rated value.
 - 2. System Test Message: Initiated manually by a test switch within the transmitter cabinet, or automatically at an optionally preselected time, once every 24 hours, with transmission time controlled by a programmed timing device integral to transmitter controls.
 - 3. Transmitter Trouble Message: Actuated by failure, in excess of one-minute duration, of the transmitter normal power source, derangement of the wiring of the transmitter, or any alarm input interface circuit or device connected to it.

4. Local Fire-Alarm-System Trouble Message: Initiated by events or conditions that cause a trouble signal to be indicated on the building system.
5. Local Fire-Alarm-System Alarm Message: Actuated when the building system goes into an alarm state. Identifies device that initiated the alarm.
6. Local Fire-Alarm-System Supervisory-Alarm Message: Actuated when the building alarm system indicates a supervisory alarm.

2.14 DEVICE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
 1. Factory fabricated and furnished by manufacturer of device.
 2. Finish: Paint of color to match the protected device.

2.15 BACK BOXES

- A. Description: For surface mount applications the device back box shall be as manufactured by the fire alarm manufacturer so that the back box matches the length and width dimensions of the device and shall match the color of the device. Standard pressed steel back boxes shall not be acceptable.

2.16 WIRE AND CABLE

- A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.
- B. Initiating-Device, Notification-Appliance, and Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer, Type FPLP MC cable, copper drain wire, copper armor with outer jacket with red identifier stripe, UL listed for fire alarm and cable tray installation, plenum rated. Boxes and covers shall be factory painted red. Field painting shall not be permitted.
- C. Non-Power-Limited Circuits:
 1. Multiconductor Armored Cable: NFPA 70 Type MC, copper conductors, TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, UL listed for fire alarm and cable tray installation, plenum rated.

PART 3 - EXECUTION

3.01 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.
 1. Comply with requirements for seismic-restraint devices specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Smoke- or Heat-Detector Spacing:
 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.

3. Smooth ceiling spacing shall not exceed 30 feet.
 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B in NFPA 72.
 5. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
 6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.
- D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- E. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- F. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- G. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.
- H. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- I. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.

3.02 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
1. Alarm-initiating connection to activate lighting controls.
 2. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 3. Supervisory connections at valve supervisory switches.
 4. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

3.03 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.
- C. Initiating devices shall be labeled with a P-Touch label, visible when standing in front of the device, indicating the device label matching the identification in the fire alarm system program.

3.04 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.05 FIELD QUALITY CONTROL

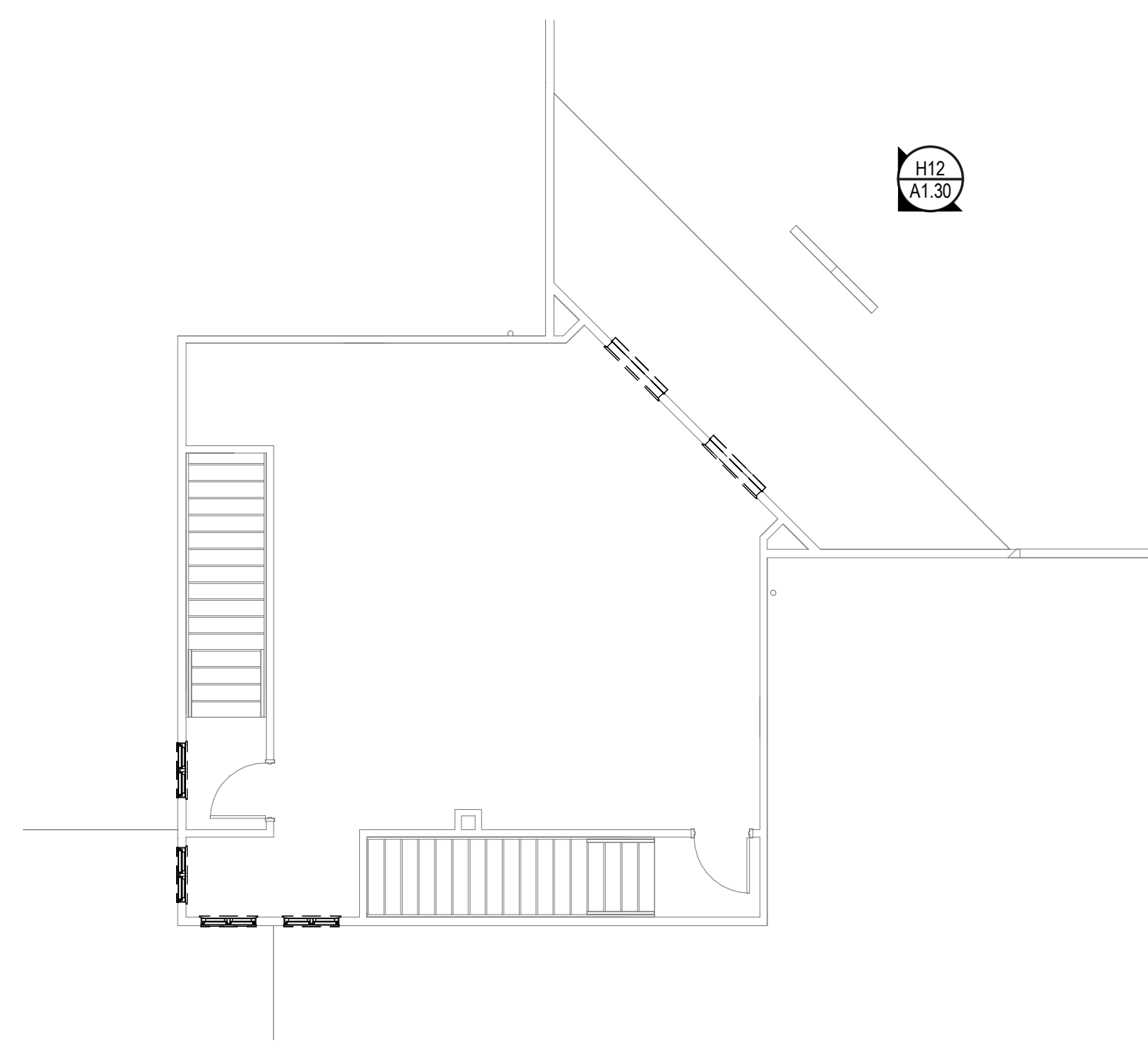
- A. Field tests shall be witnessed by Architect, authorities having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 - 4. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 - 5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.06 DEMONSTRATION

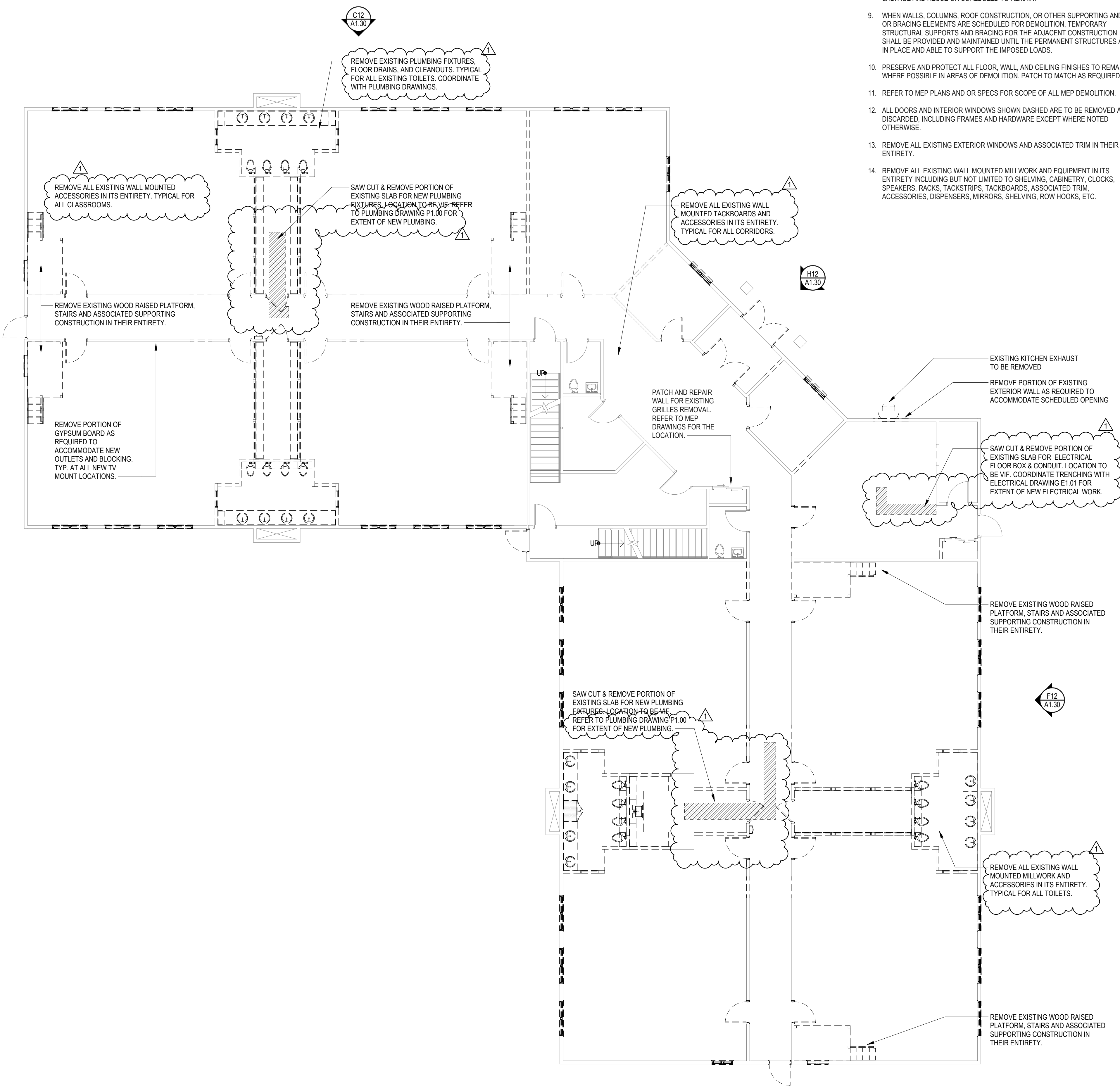
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION

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G10 MEZZ. FLOOR DEMOLITION PLAN
1/8" = 1'-0"



K8 FIRST FLOOR DEMOLITION PLAN
1/8" = 1'-0"

DEMOLITION LEGEND

- EXISTING ITEMS
- ITEMS TO BE REMOVED
- ESTIMATED SAW CUT SLAB DEMO AND TRENCHING EXENTS. PLUMBING AND ELECTRICAL TIE IN LOCATIONS TO BE VIF. REMEP

GENERAL NOTES - DEMOLITION

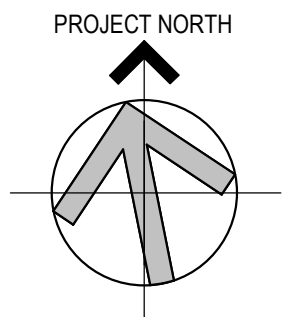
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING ALL EXISTING CONDITIONS IN THE FIELD PRIOR TO ANY DEMOLITION OR CONSTRUCTION. ANY DISCREPANCIES RELATING TO THE DRAWINGS SHALL BE REPORTED TO THE ARCHITECT IMMEDIATELY.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL DEMOLITION AND REMOVAL NECESSARY TO COMPLETE THE WORK. THE CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR THE REMOVAL AND PROPER DISPOSAL, INCLUDING ALL COSTS FOR CARRYING AND DUMPING, OF ALL MATERIAL DEMOLISHED FROM THE PROJECT. THE CONTRACTOR SHALL PROVIDE OWNER WITH FIRST RIGHTS TO ALL MATERIALS, INCLUDING DOORS, HARDWARE, WINDOWS, PLUMBING FIXTURES, ETC., BEFORE REMOVING FROM SITE.
- THE CONTRACTOR IS TO BE AWARE OF SELECTIVE DEMOLITION AT ALL SECTIONS OF THE WORK, REVIEWING ALL NEW AND REHABILITATION DETAILS TO DETERMINE THAT WHICH IS TO BE REMOVED OR TO REMAIN, AND WILL BE RESPONSIBLE FOR REPLACEMENT IN-KIND ALL WORK INADVERTENTLY REMOVED.
- THE CONTRACTOR SHALL REMOVE ITEMS TO BE DEMOLISHED AS INDICATED ON THE DRAWINGS WITH CARE BEING TAKEN NOT TO DAMAGE ADJACENT WALLS, CEILINGS, FLOORS, FINISHES, CASEWORK OR MILLWORK SCHEDULED TO REMAIN. THE WORK AREA SHALL BE LEFT READY TO RECEIVE NEW WORK.
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- PRESERVE AND PROTECT ALL FLOOR, WALL, AND CEILING FINISHES TO REMAIN WHERE POSSIBLE IN AREAS OF DEMOLITION. PATCH TO MATCH AS REQUIRED.
- REFER TO MEP PLANS AND OR SPECS FOR SCOPE OF ALL MEP DEMOLITION.
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- REMOVE ALL EXISTING EXTERIOR WINDOWS AND ASSOCIATED TRIM IN THEIR ENTIRETY.
- REMOVE ALL EXISTING WALL MOUNTED MILLWORK AND EQUIPMENT IN ITS ENTIRETY INCLUDING BUT NOT LIMITED TO SHELVING, CABINETRY, CLOCKS, SPEAKERS, RACKS, TACKSTRIPS, TACKBOARDS, ASSOCIATED TRIM, ACCESSORIES, DISPENSERS, MIRRORS, SHELVING, ROW HOOKS, ETC.

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Issues / Revisions		
No.	Date	Description
001/15/2025		SCHEMATIC DESIGN SUBMISSION
12/05/2025		DESIGN DEVELOPMENT
01/25/2026		100% CONSTRUCTION DOCUMENTS
02/11/2026		ADDENDUM 2

Drawing Title
DEMOLITION FLOOR PLANS

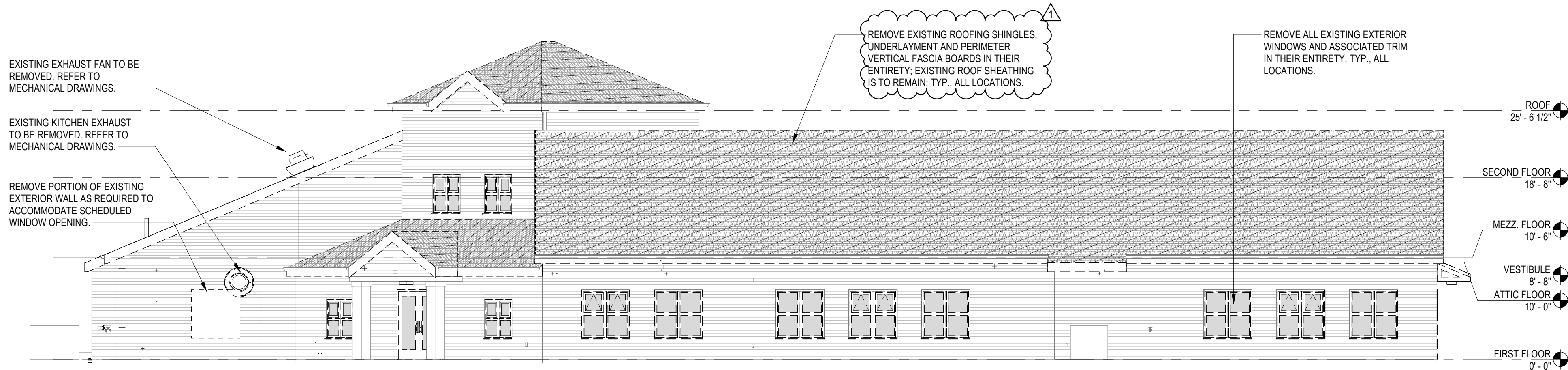
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Project Architect:	AC	Production Leader:	NA
Project Designer:	KM	Peer Reviewer:	EW

Drawing Number
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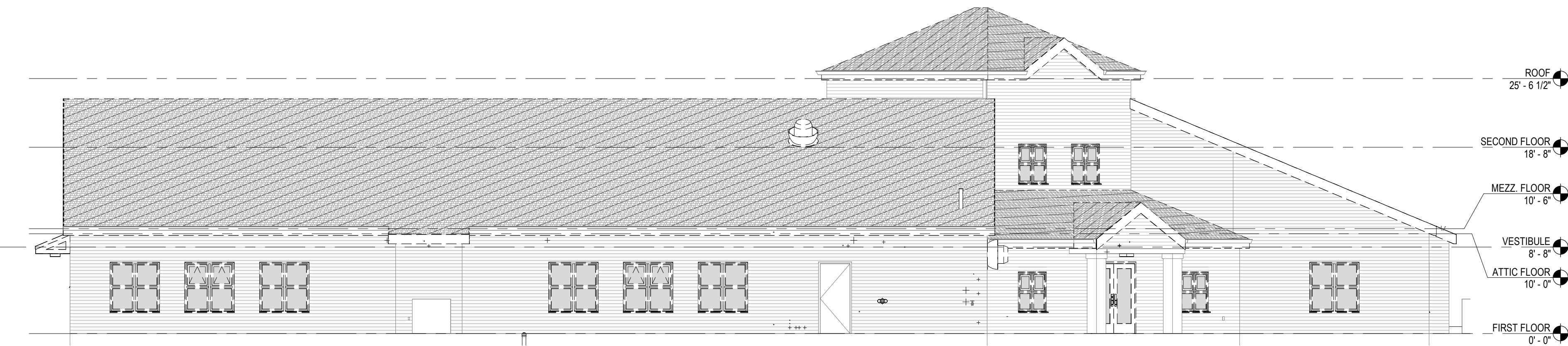
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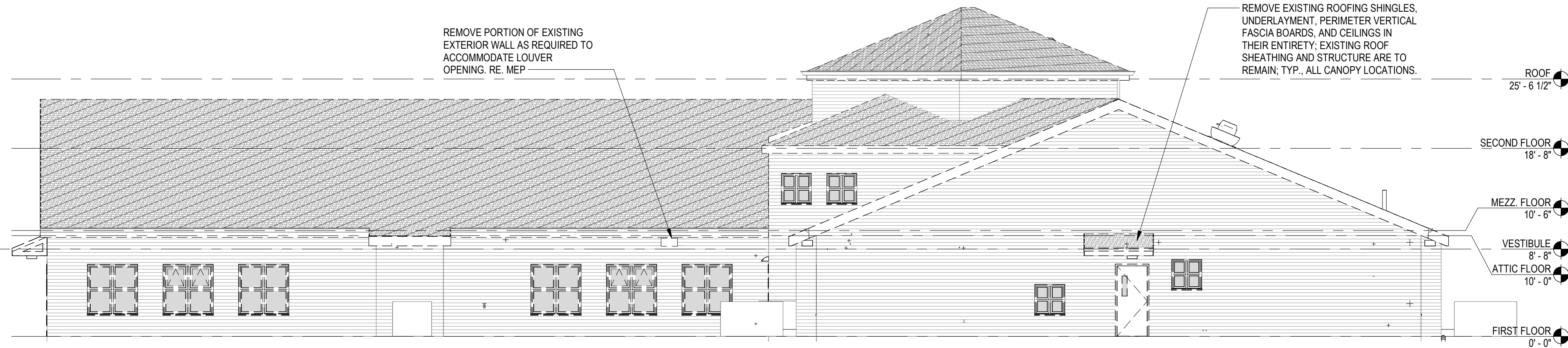
C12 NORTH ELEVATION
1/8" = 1'-0"



F12 EAST ELEVATION
1/8" = 1'-0"



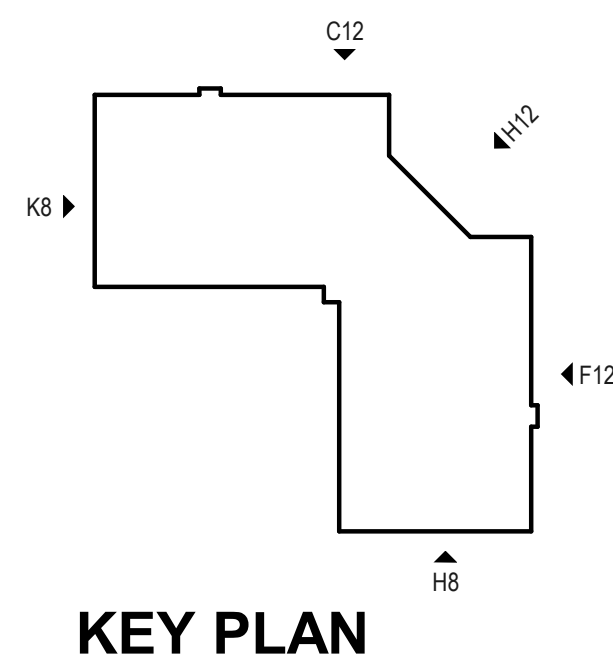
H12 NORTH-EAST ELEVATION
1/8" = 1'-0"



H8 SOUTH ELEVATION
1/8" = 1'-0"



K8 WEST ELEVATION
1/8" = 1'-0"



KEY PLAN

GENERAL NOTES - DEMOLITION

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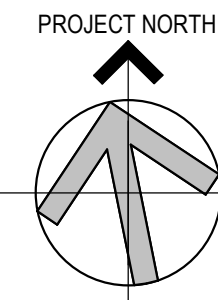
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001/15/2025	001/15/2025	SCHEMATIC DESIGN SUBMISSION
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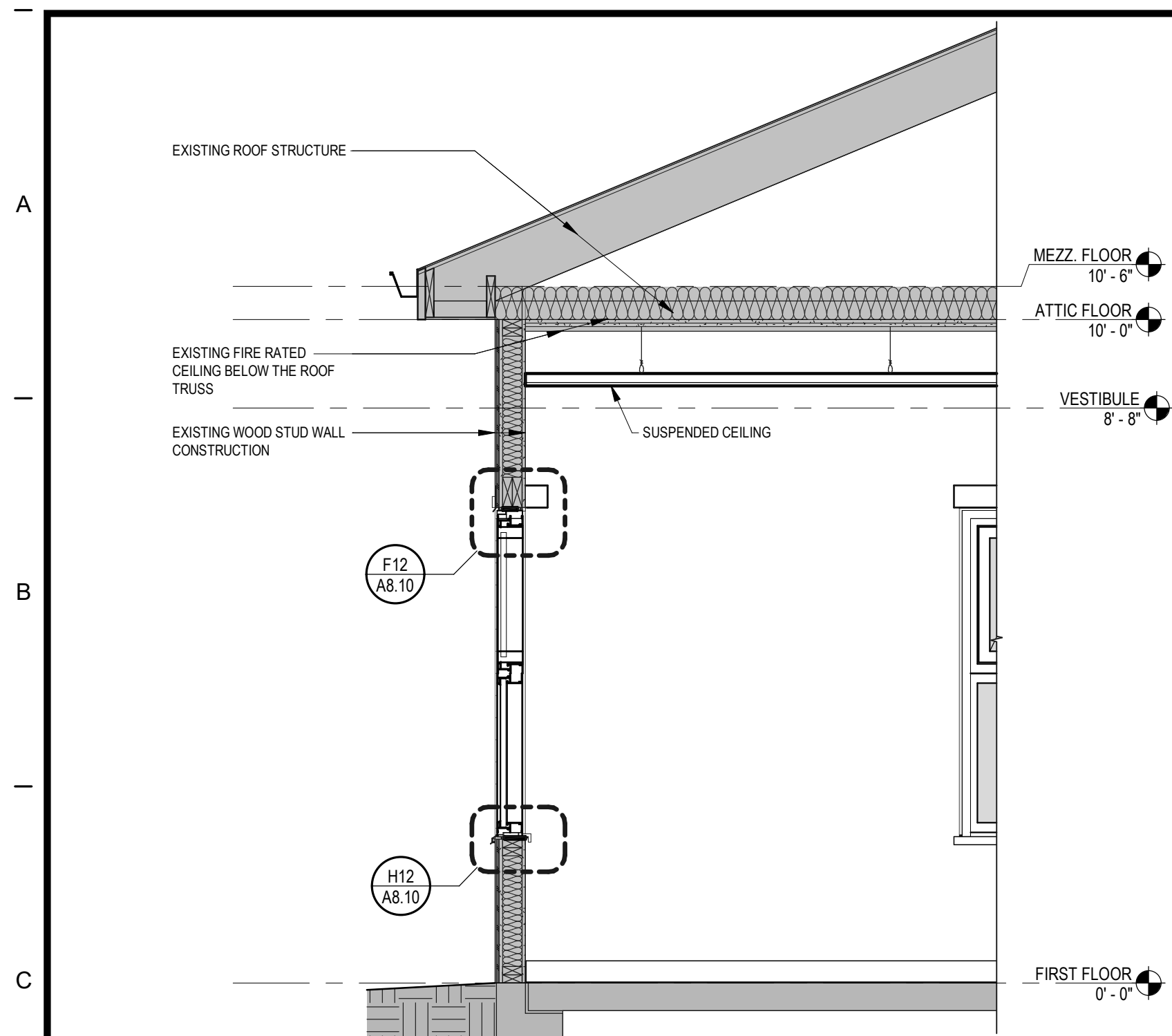
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**DEMOLITION
EXTERIOR
ELEVATIONS**

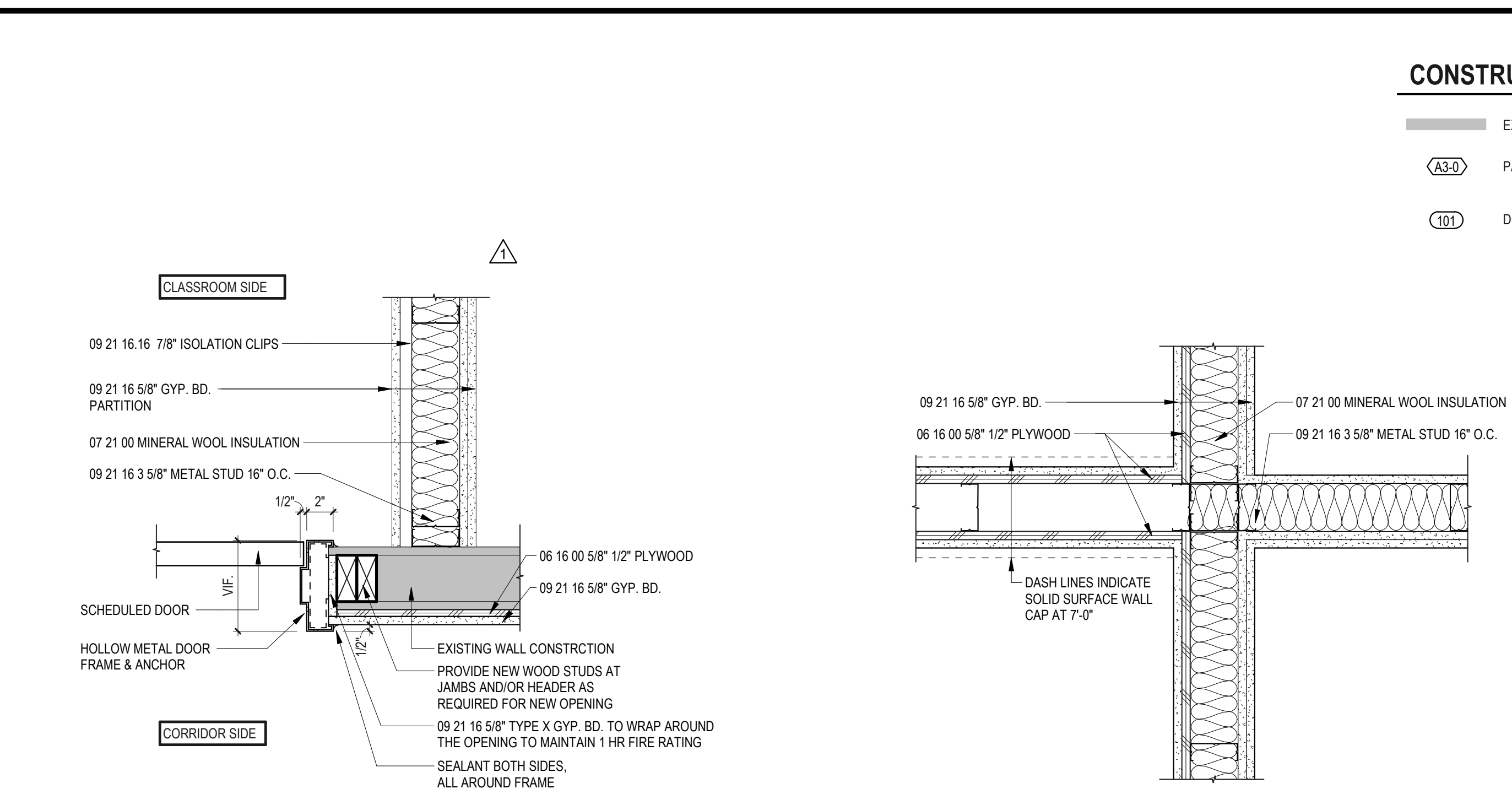
Project Manager:	JH	Project No:	WWEIG2AR
Project Architect:	AC	Production Leader:	NA
Project Designer:	KM	Peer Reviewer:	EW

Drawing Number

A1.30



C12 TYPICAL WALL SECTION AT WINDOW
1/2" = 1'-0"



C8 WALL TRANSITION FROM EXISTING TO NEW
1 1/2" = 1'-0"

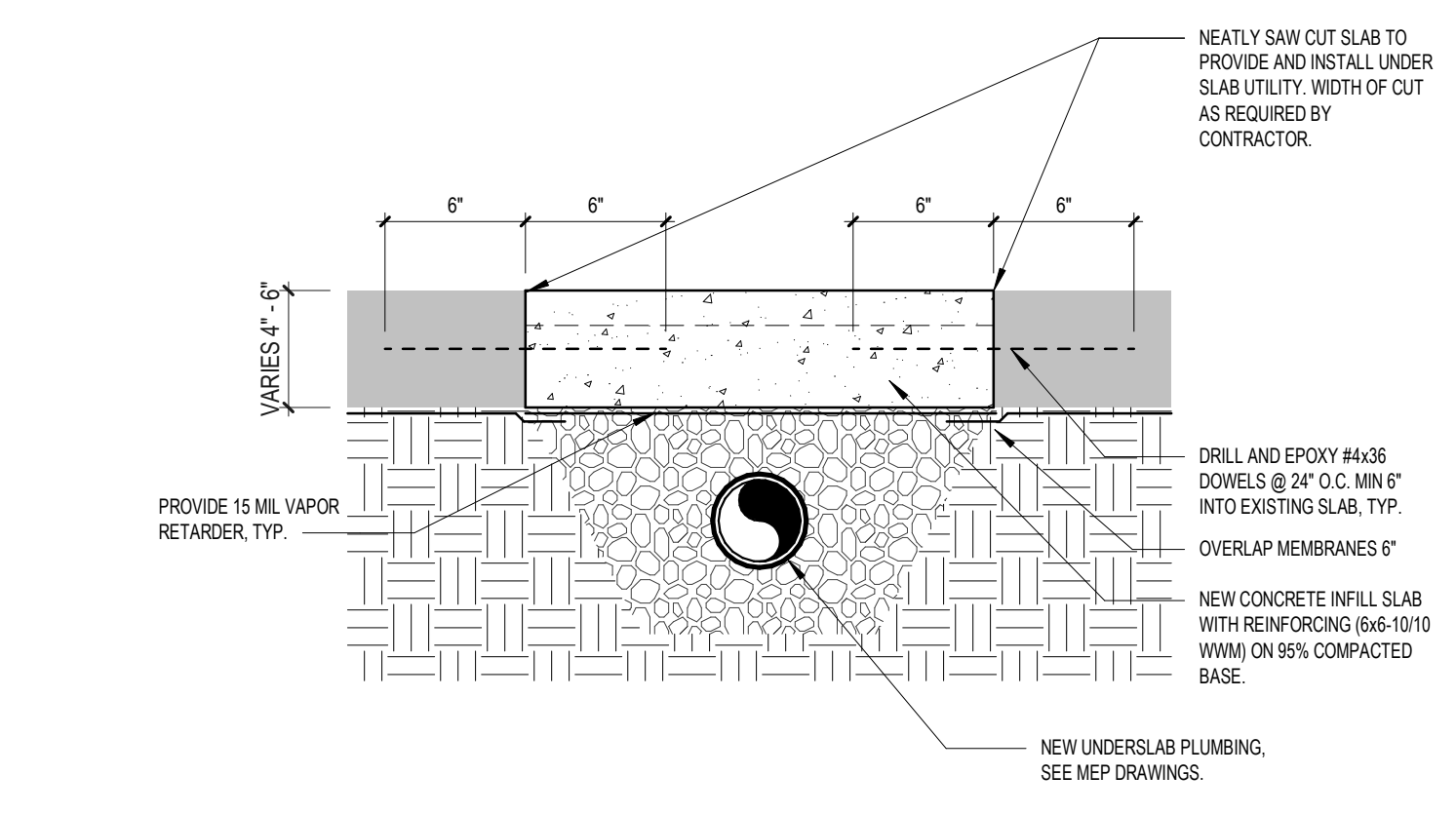
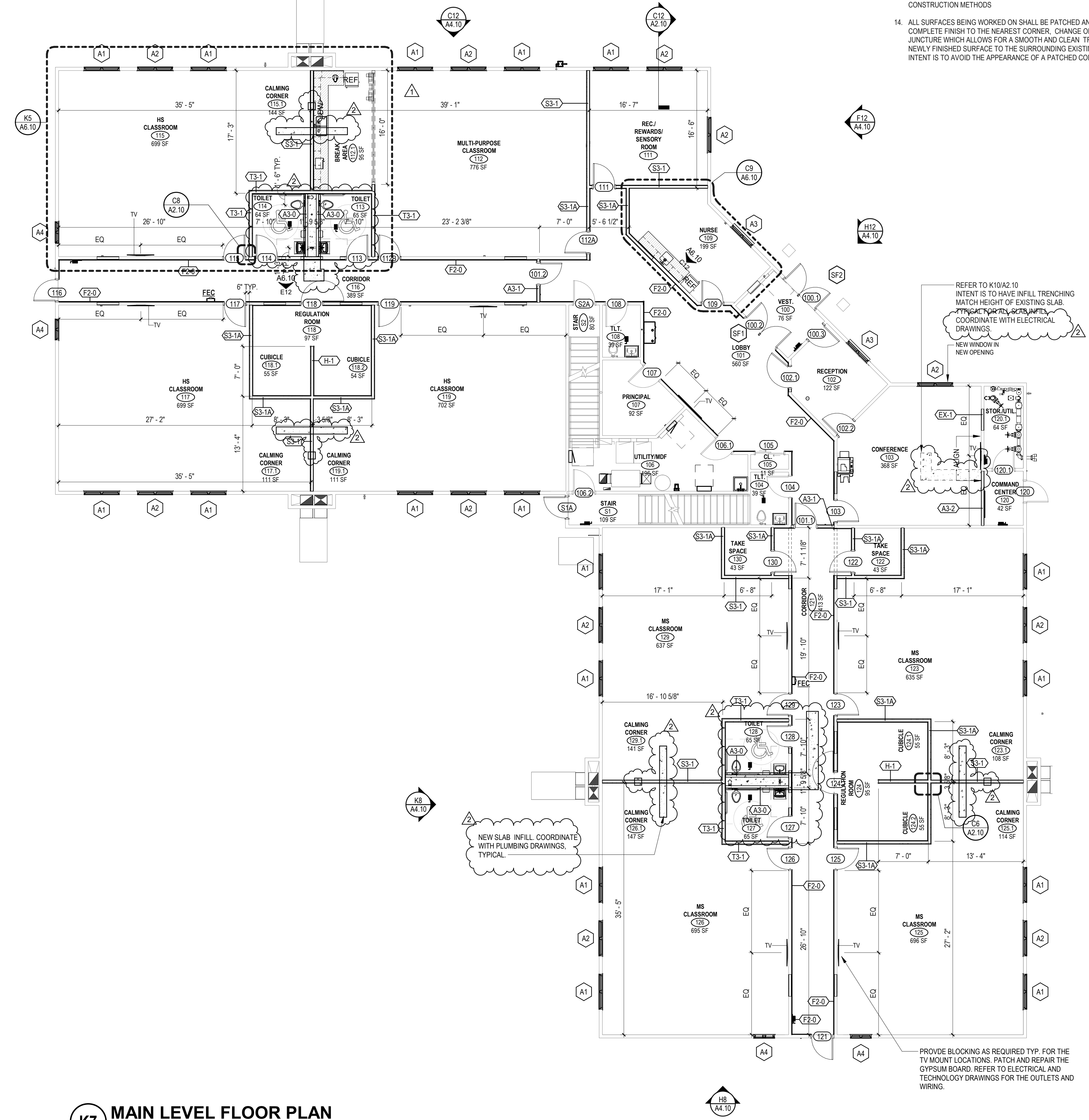
C6 PLAN DETAIL AT CUBICLE WALLS
1 1/2" = 1'-0"

CONSTRUCTION LEGEND

	EXISTING ITEMS		NEW CONSTRUCTION
	PARTITION TAG		HATCH DENOTES MILLWORK
	DOOR TAG		WINDOW TAG
			CORNER GUARD (CG-1)
			ESTIMATED NEW CONCRETE INFILL SLAB

GENERAL NOTES - CONSTRUCTION

- WHERE TWO DENOTED WALL TYPES COINCIDE, THE MOST STRINGENT OF BOTH WALL CONSTRUCTION DEFINITIONS APPLIES TO THAT WALL (i.e. FIRE CODE GYPSUM BATT INSULATION), WHERE A RATED CONSTRUCTION BEGINS/TERMINATES AT AN EXISTING COLUMN ENCLOSURE OR NEW FURRED, NON-RATED ENCLOSURE, THE HIGHER RATING MUST BE PROVIDED. THE INTENT IS TO PROVIDE A COMPLETE ENVELOPE OF INTENDED DESIGN RATINGS.
- PROVIDE SOLID WOOD BLOCKING FOR ALL INDICATED WALL HUNG EQUIPMENT.
- FIRE SAFE ALL PENETRATIONS IN RATED WALL ASSEMBLIES. SEE TYPICAL RATED WALL PENETRATION DETAIL.
- ALIGN FACE OF NEW FINISH WITH FACE OF EXISTING FINISH AT ALL GYPSUM BOARD INFILL CONSTRUCTION UNLESS OTHERWISE NOTED.
- VERIFY LOCATION OF ALL ACCESS PANELS WITH MEP EQUIPMENT.
- ALL DIMENSIONS SHALL BE FIELD VERIFIED BY THE CONTRACTOR AND ANY DISCREPANCIES SHALL BE PROMPTLY REPORTED TO THE ARCHITECT.
- WHERE THE DRAWINGS AND SPECIFICATIONS CONFLICT THE MOST STRINGENT, GREATEST QUANTITY AND OR BEST QUALITY SHALL BE USED.
- FIRE RATED PARTITIONS INDICATED ON THE FLOOR PLANS ARE COMPONENTS OF CONTINUOUS RATED ASSEMBLIES CONSISTING OF WALLS, FLOOR, DOORS, INTERIOR BORROWED LIGHTS, MECHANICAL PENETRATIONS AND CEILING. REFER TO PLANS AND SPECIFICATIONS FOR METHODS OR ACHIEVING THE NECESSARY RATINGS. WHERE THE SPECIFIC METHOD OF ACHIEVING THE RATING IS NOT INDICATED, OBTAIN CLARIFICATION FROM ARCHITECT PRIOR TO BIDDING.
- PATCH, REPAIR, AND REFINISH ALL SURFACES EXPOSED BY DEMOLITION WORK OR CUTTING TO ALIGN WITH EXISTING SURFACES SCHEDULED TO REMAIN OR NEW FINISHES SPECIFIED.
- ALL EXISTING FINISHED REMAINING IN PLACE (i.e. CARPET, VCT, CEILING, ETC.) SHALL BE CLEANED UTILIZING EFFECTIVE CLEANING METHODS WHICH WILL PRODUCE THE MOST DESIRABLE RESULTS POSSIBLE.
- WHERE DOORS IN METAL STUD PARTITIONS ARE NOT SPECIFICALLY LOCATED ON THE PLANS WITH DIMENSION STRINGS, PROVIDE A MINIMUM HINGE SIDE JAMB DIMENSION OF 6" WHERE DOORS APPEAR TO BE CENTERED WITHIN PARTITIONS, LOCATE THE DOOR IN THE CENTER OF THE PARTITION.
- CALLK ALL JOINT OR CRACKS WHICH OCCUR WHERE DISSIMILAR MATERIALS INTERSECT PERPENDICULAR TO EACH OTHER AND THE INTERSECTION IS EXPOSED TO VIEW UNLESS INDICATED OTHERWISE ON THE DRAWINGS.
- ALL SITE ELEMENTS (e.g. FLAT WORK, LANDSCAPING, CONCRETE STAIRS, ETC.) ARE SHOWN FOR REFERENCE ONLY. REFER TO CIVIL DRAWINGS FOR DESIGN AND CONSTRUCTION METHODS.
- ALL SURFACES BEING WORKED ON SHALL BE PATCHED AND REPAIRED WITH A COMPLETE FINISH TO THE NEAREST CORNER, CHANGE OF PLANE OR OTHER JUNCTURE WHICH ALLOWING FOR A SMOOTH AND CLEAN TRANSITION FROM THE NEWLY FINISHED SURFACE TO THE SURROUNDING EXISTING SURFACES (THE INTENT IS TO AVOID THE APPEARANCE OF A PATCHED CONDITION).



K10 SLAB INFILL DETAIL AT PIPE TRENCHES
1 1/2" = 1'-0"

K7 MAIN LEVEL FLOOR PLAN
1/8" = 1'-0"

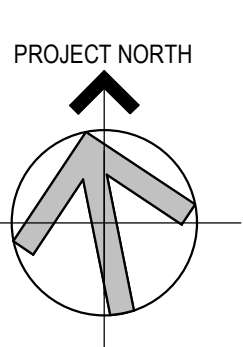
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No.	Date	Description
001/15/2025	001/15/2025	SCHEMATIC DESIGN SUBMISSION
12/05/2025	12/05/2025	DESIGN DEVELOPMENT
01/26/2026	01/26/2026	100% CONSTRUCTION DOCUMENTS
01/29/2026	01/29/2026	ADDENDUM 1
02/11/2026	02/11/2026	ADDENDUM 2

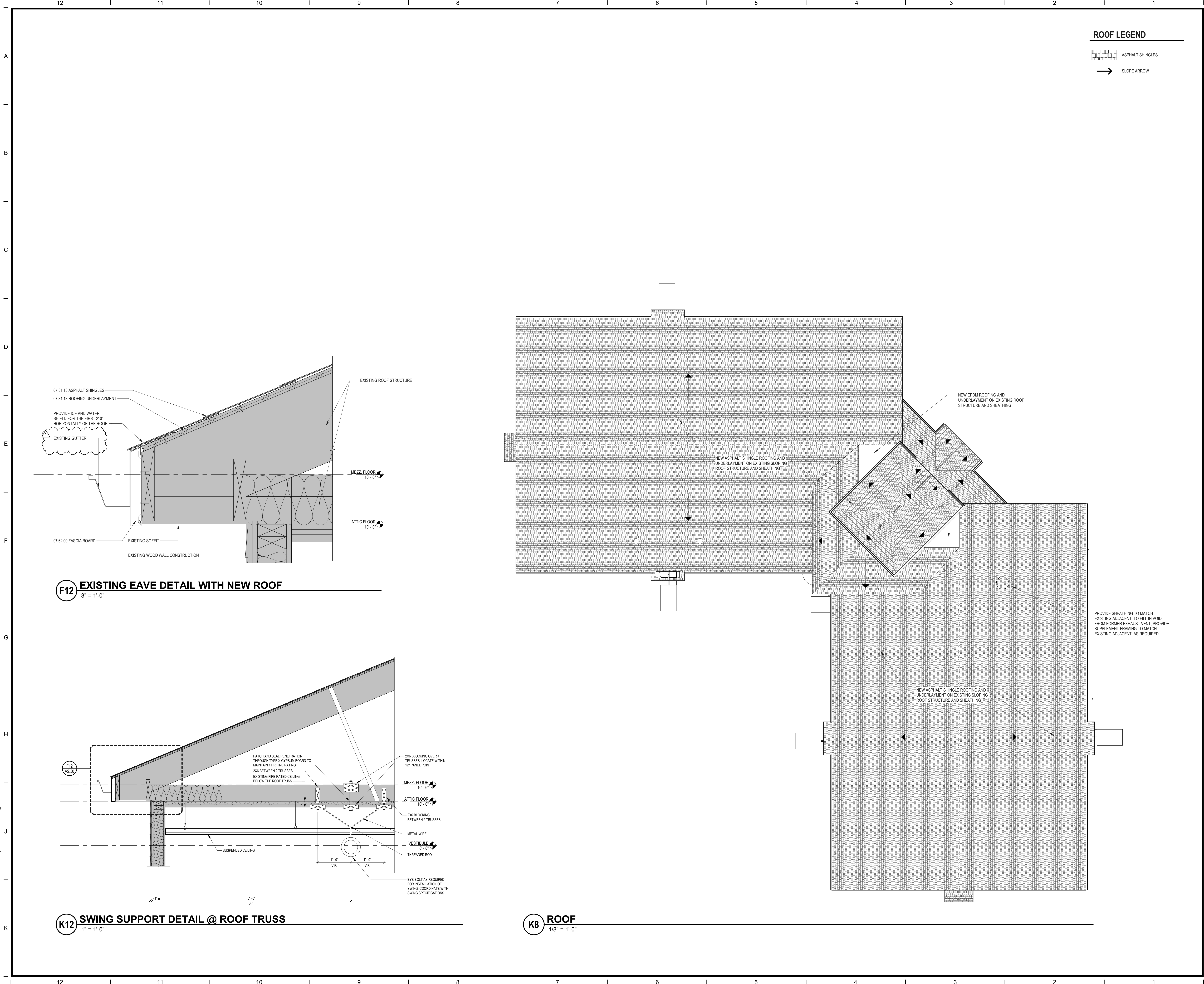
Drawing Title
**MAIN LEVEL
FLOOR PLAN,
SECTIONS, &
DETAILS**

Project Manager:	JH	Project No:	WWE024R
Project Architect:	AC	Production Leader:	NA
Project Designer:	KM	Peer Reviewer:	EW

Drawing Number

A2.10

2/12/2025 1:32:15 PM Autodesk Docs\\WWE02AR - 30 Payan Street\\WWE02AR_ARCH.rvt



ROOF LEGEND

- ASPHALT SHINGLES
- SLOPE ARROW

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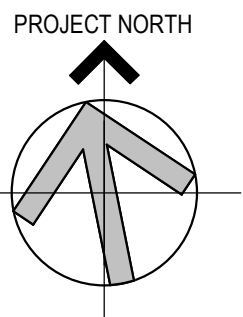
**WEST WARWICK
PUBLIC SCHOOLS**

10 Harris Ave
West Warwick, RI 02893

Project

30 PAYAN ST

30 PAYAN STREET
WEST WARWICK, RI 02893



Seals

Issues / Revisions	
No.	Description
001/15/2025	SCHEMATIC DESIGN SUBMISSION
12/05/2025	DESIGN DEVELOPMENT
01/25/2026	100% CONSTRUCTION DOCUMENTS
02/11/2026	ADDENDUM 2

Drawing Title

**ROOF PLAN &
ROOF DETAILS**

Project Manager:	JH	Project No:	WWE02AR
Project Architect:	AC	Production Leader:	NA
Project Designer:	KM	Peer Reviewer:	EW

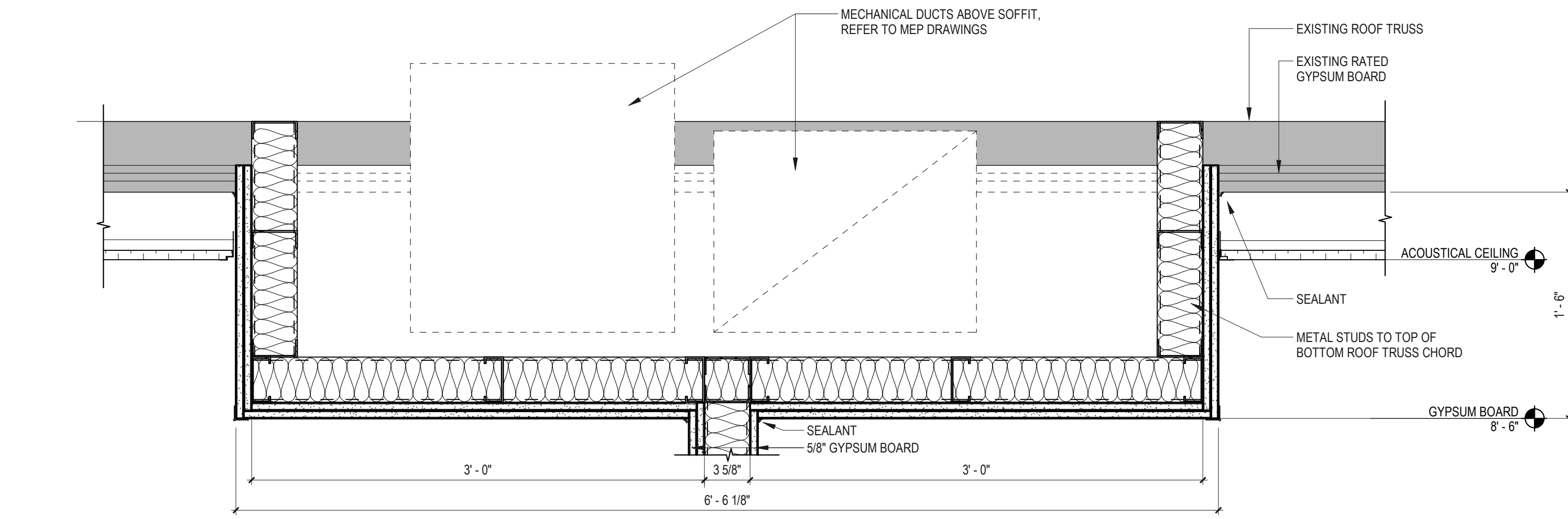
Drawing Number

A2.30

2/12/2025 1:32:28 PM Autodesk Docs\\WWEIG2AR - 30 Payan Street\\WWEIG2AR_ARCH.rvt

C12 GYPSUM SOFFIT DETAIL AT CLASSROOMS

1 1/2" = 1'-0"



REFLECTED CEILING PLAN LEGEND

ROOM NAME	ROOM NAME	NEW CONSTRUCTION	CEILING TAG
ACoustical CEILING		2X4 LIGHT FIXTURE	
GYPSUM BOARD CEILING ETR		ROUND RECESSED DOWNLIGHT	
NEW GYPSUM BOARD CEILING		PENDANT LIGHT FIXTURE	
VINYL BOARD		SURFACE MOUNT LIGHT FIXTURE	
AREA 1 REPLACE EXISTING LIGHT FIXTURES WITH NEW AND SUBSTITUTE CEILING TILES. REUSE & PAINT EXISTING CEILING GRIDS THROUGHOUT.		SURFACE MOUNT LIGHT FIXTURE	
AREA 2 REPLACE EXISTING CEILING TILES, GRIDS AND LIGHT FIXTURES WITH NEW.		SURFACE MOUNT LIGHT FIXTURE	

GENERAL NOTES - CEILING

- SEE WALL TYPES FOR INDICATION WHERE WALLS PENETRATE CEILING GRIDS.
- UNLESS SPECIFICALLY NOTED OTHERWISE, ALL CEILING GRIDS AND LIGHTING SHALL BE CENTERED, WITH BALANCED CUTS.
- ALL CEILING ITEMS ARE TO BE CENTERED IN 2x4, 2x2 OR IMPLIED 2x2 CEILING TILE, WHICHEVER APPLIES. THIS PLAN IS INTENDED FOR COORDINATION AND LOCATION PURPOSES ONLY. SEE MEP FOR SPECIFIC CEILING MOUNTED ITEMS.
- AT AREAS OF NEW CONSTRUCTION WHERE THE EXISTING CEILING IS TO REMAIN, THE CONTRACTOR WILL BE RESPONSIBLE FOR PATCHING AND REPAIRING THE EXISTING CEILING AS NECESSARY.
- ALL PENETRATIONS THROUGH TYPE X GYPSUM BOARD IN THE ONE-HOUR RATED CEILING ABOVE THE ACOUSTIC CEILING MUST BE PROPERLY PATCHED AND SEALED TO ENSURE THE INTEGRITY OF THE ONE-HOUR FIRE RATING IS MAINTAINED.
- ALL EXISTING CEILING GRIDS TO REMAIN SHALL BE CLEANED UTILIZING EFFECTIVE CLEANING METHODS WHICH WILL PRODUCE THE MOST DESIRABLE RESULT POSSIBLE.
- IN AREAS WHERE EXISTING CEILING GRIDS ARE REMAINING AND NEW ACOUSTIC CEILING TILES ARE BEING INSTALLED, CAUTION IS TO BE TAKEN TO NOT DISTURB EXISTING ABOVE-CEILING CONDITIONS.
- ALL DRYWALL CEILINGS TO RECEIVE FLAT WHITE CEILING PAINT.
- ALL EXTERIOR WINDOWS TO RECEIVE NEW WINDOW TREATMENT RS-1. REFER TO MATERIAL LIST AND SPECIFICATIONS.

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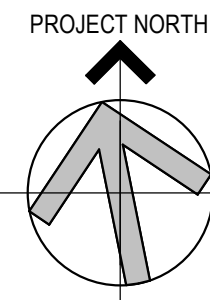
**WEST WARWICK
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10 Harris Ave
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Seals

Issues / Revisions

No.	Date	Description
0015/2025		SCHEMATIC DESIGN SUBMISSION
12/05/2025		DESIGN DEVELOPMENT
01/29/2026		100% CONSTRUCTION DOCUMENTS
02/11/2026		ADDENDUM 2

Drawing Title

**REFLECTED
CEILING PLANS
& DETAILS**

Project Manager: JH Project No: WWEIG2AR

Project Architect: AC Production Leader: NA

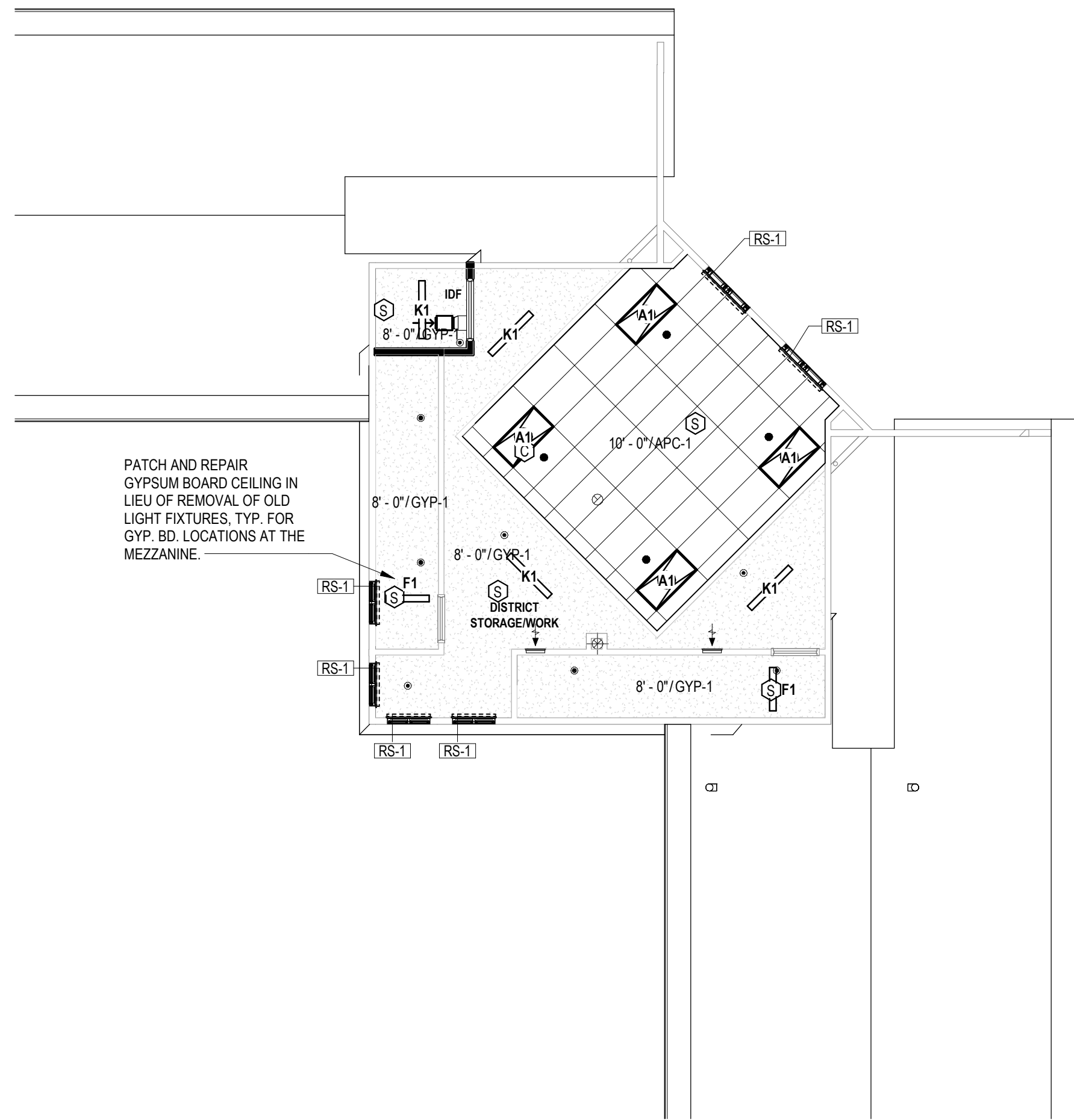
Project Designer: KM Peer Reviewer: EW

Drawing Number

A3.10

K12 MEZZANINE FLOOR REFLECTED CEILING PLAN

1/8" = 1'-0"

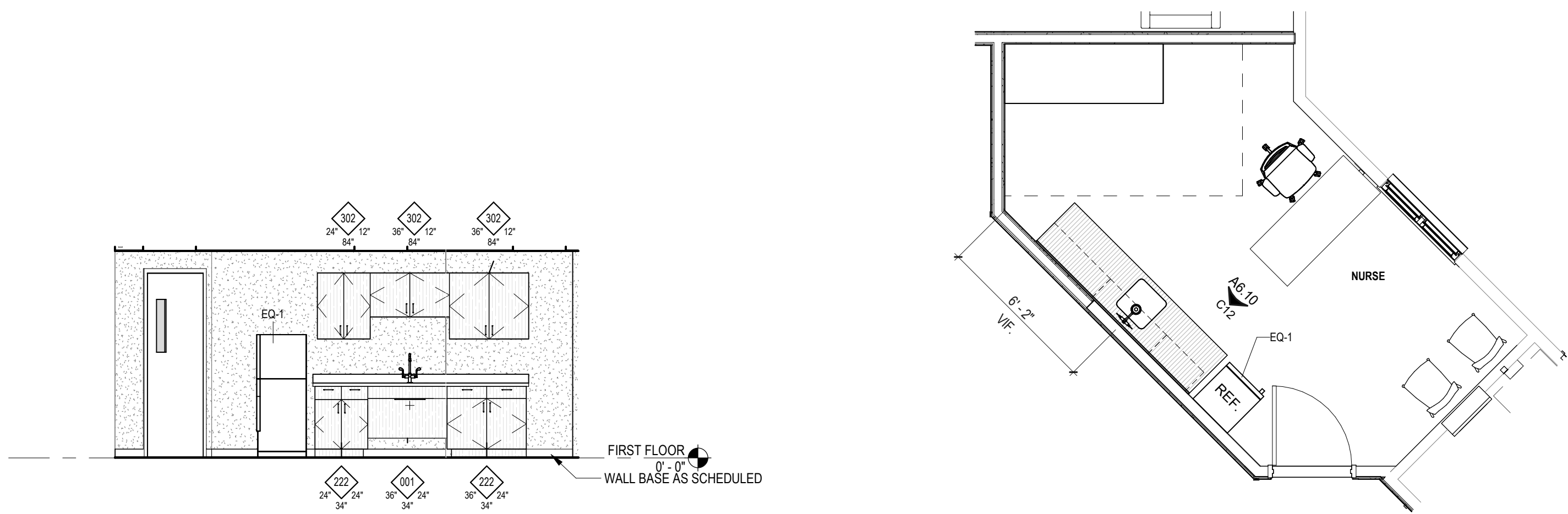


K7 FIRST FLOOR REFLECTED CEILING PLAN

1/8" = 1'-0"

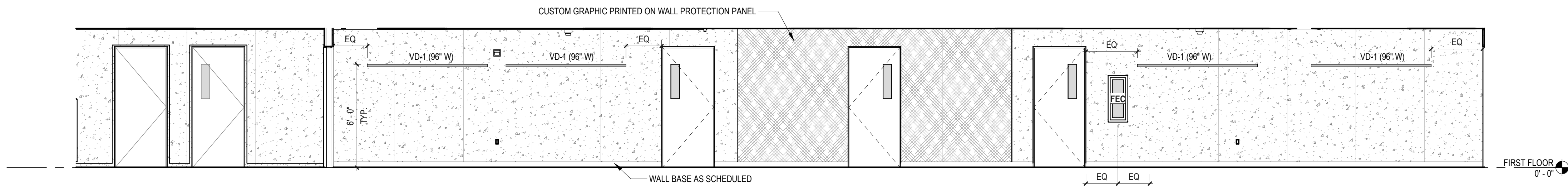


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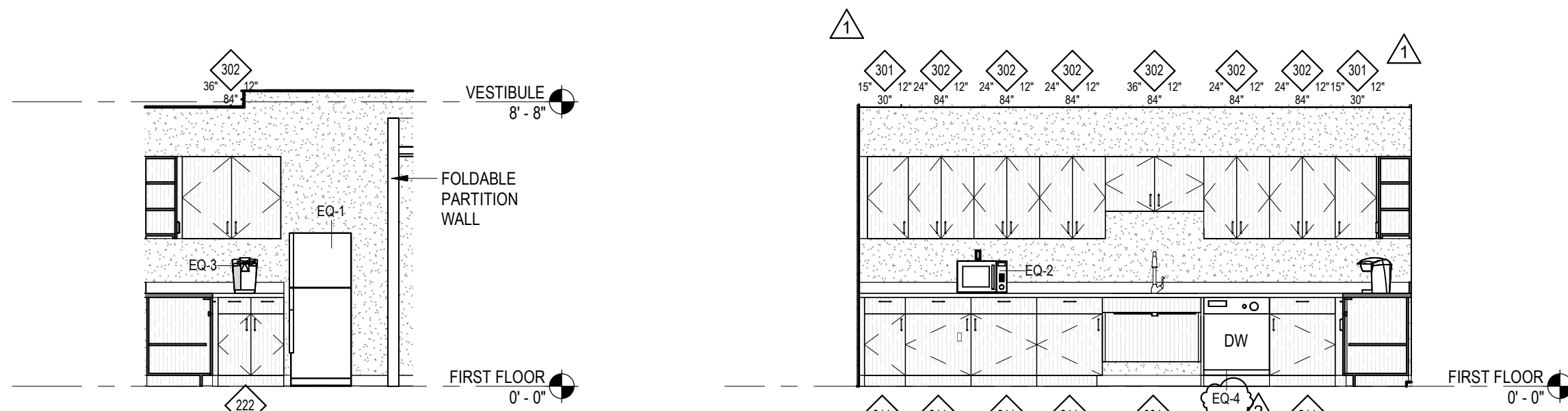


C12 NURSE - MILLWORK
1/4" = 1'-0"

C9 NURSE SUITE
1/4" = 1'-0"

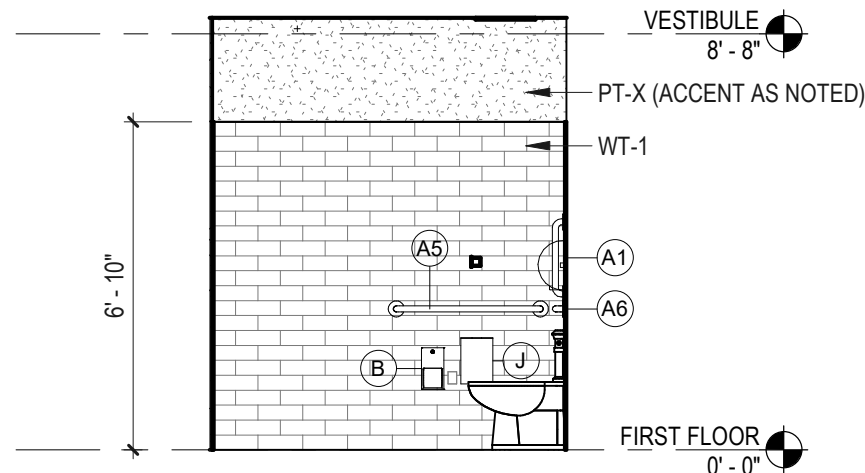


E12 TYPICAL CORRIDOR
1/4" = 1'-0"

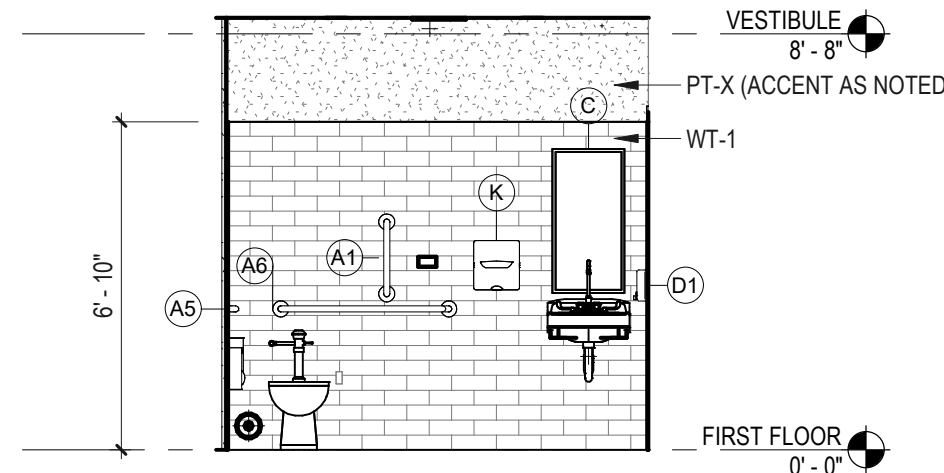


G12 BREAK ROOM - NORTH
1/4" = 1'-0"

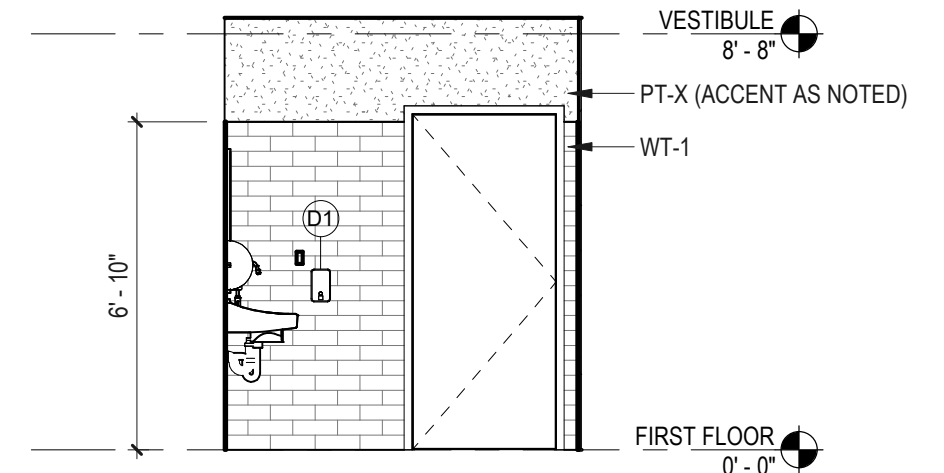
G10 BREAK ROOM - WEST
1/4" = 1'-0"



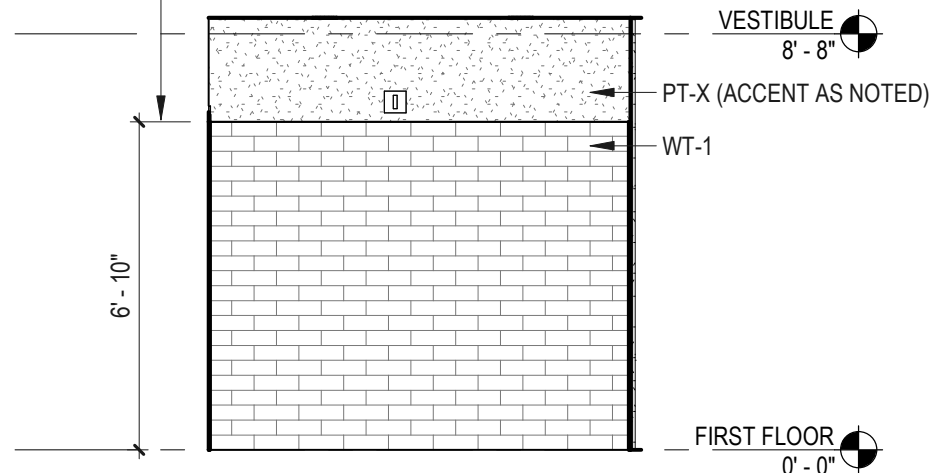
G8 TOILET - SIDE WALL
1/4" = 1'-0"



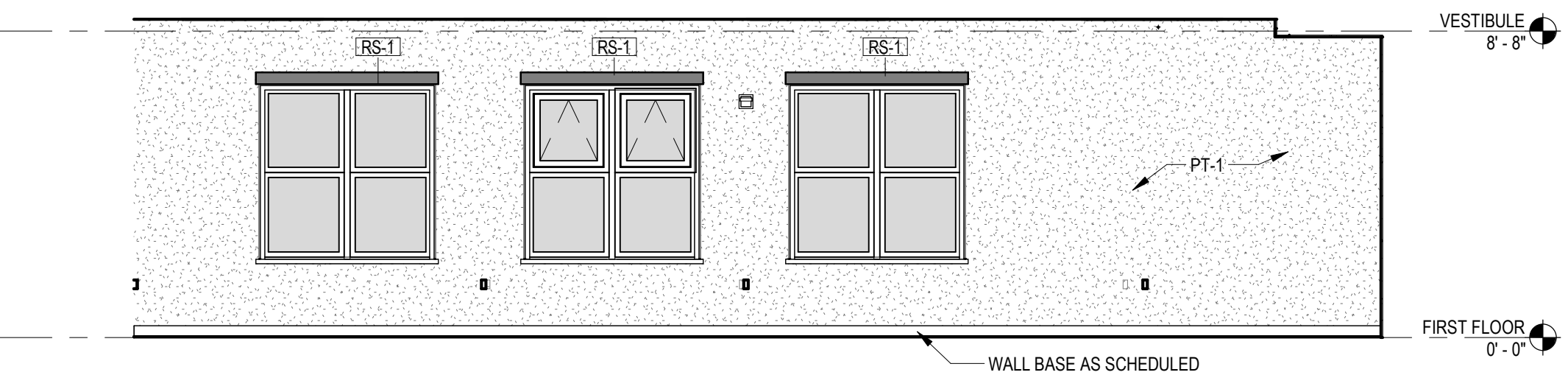
G6 TOILET - WET WALL
1/4" = 1'-0"



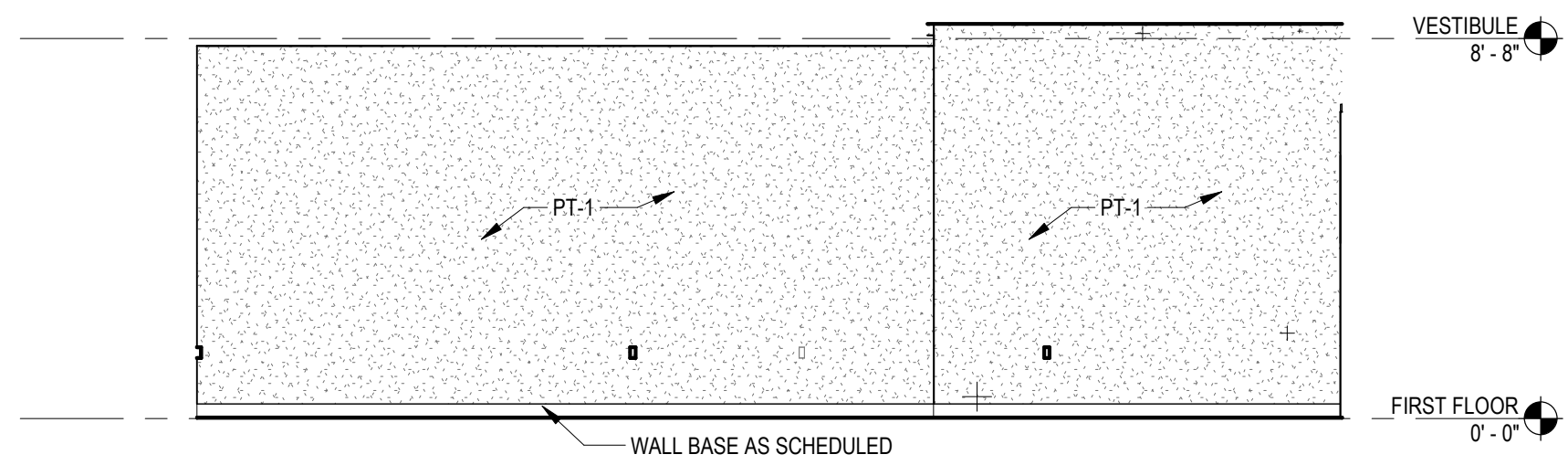
G4 TOILET - ENTRY WALL
1/4" = 1'-0"



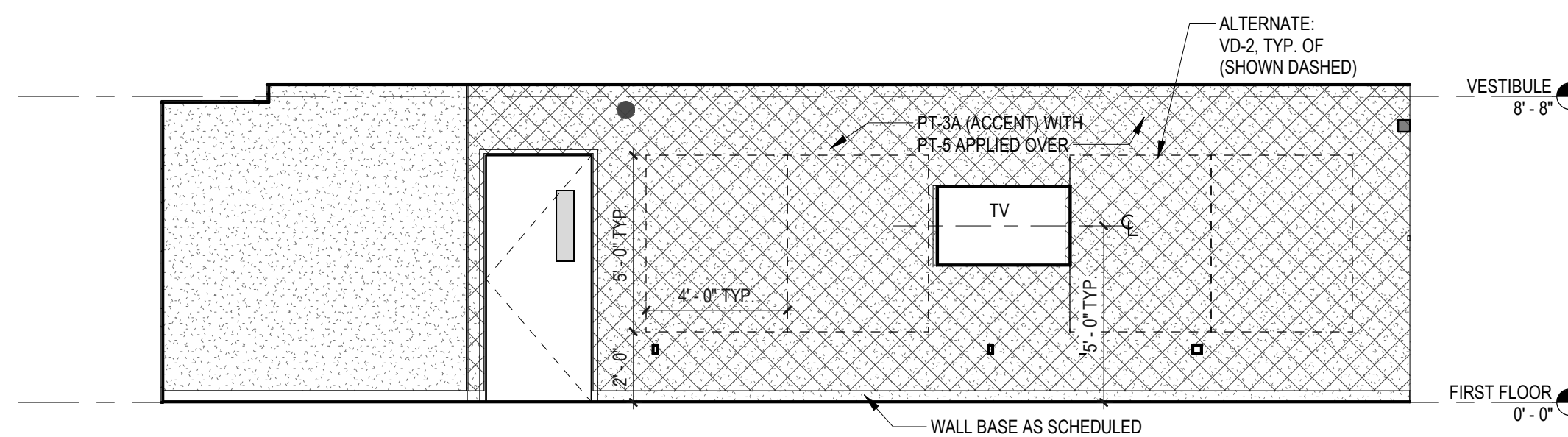
G2 TOILET - BACK WALL
1/4" = 1'-0"



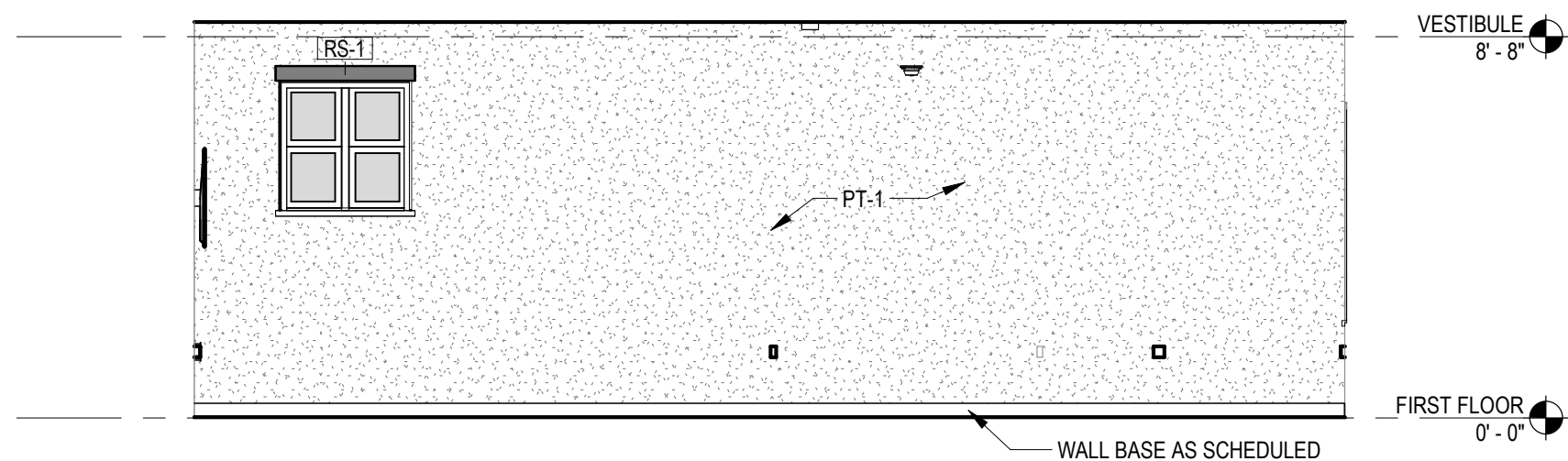
H12 WINDOW WALL
1/4" = 1'-0"



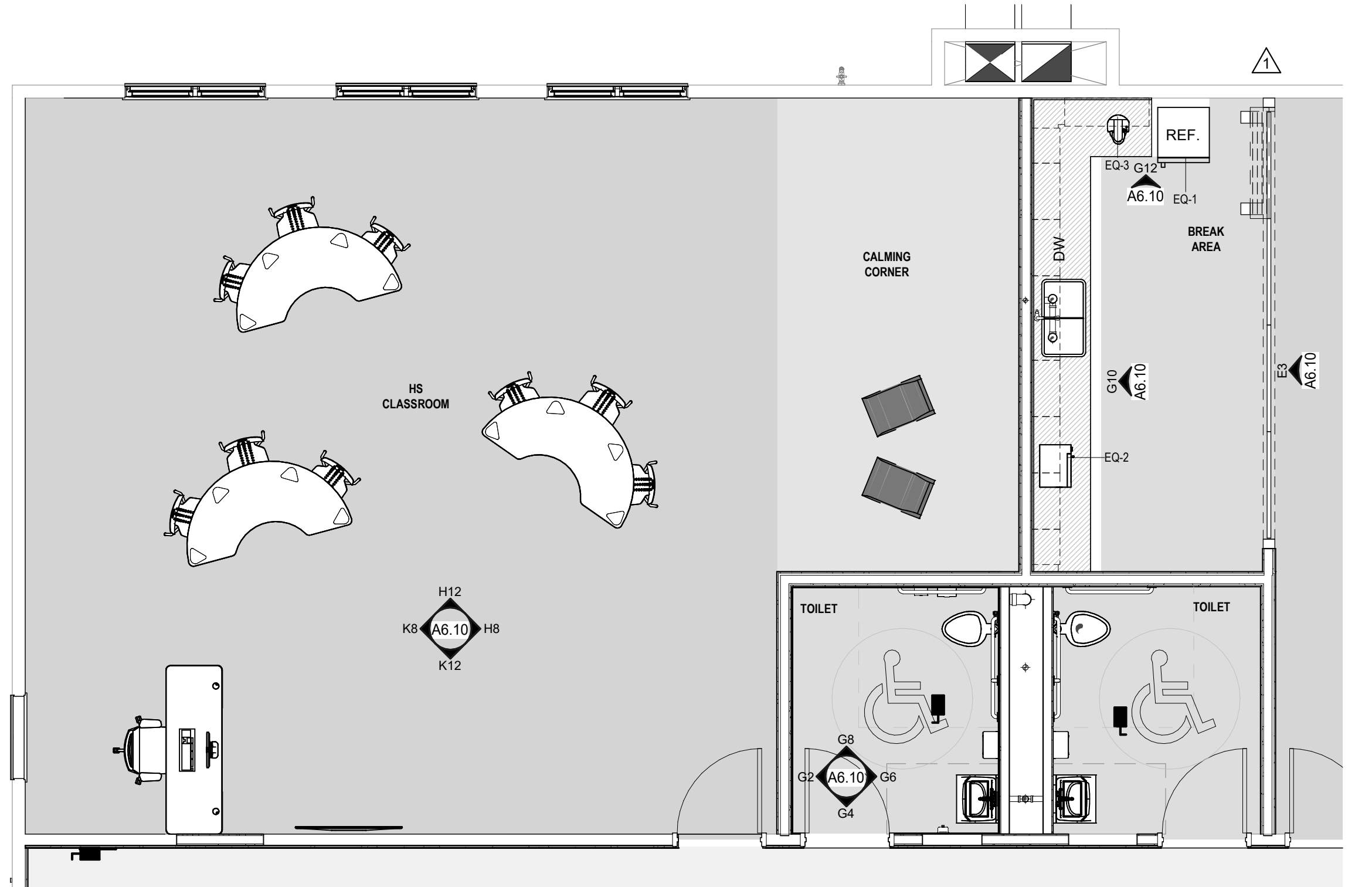
H8 SIDE WALL
1/4" = 1'-0"



K12 TEACHING WALL
1/4" = 1'-0"



K8 BACK WALL
1/4" = 1'-0"



K5 ENLARGED PLAN - TYPICAL CLASSROOM & BREAK AREA
1/4" = 1'-0"

TOILET ACCESSORIES				
Toilet Accessory Type Mark	Description	Contractor Furnished	Owner Furnished	Installation
A1	18" VERTICAL GRAB BAR	Yes		CONTRACTOR
A5	36" GRAB BAR	Yes		CONTRACTOR
A6	42" GRAB BAR	Yes		CONTRACTOR
B	TOILET TISSUE DISPENSER		Yes	OWNER
C	MIRROR	Yes		CONTRACTOR
D1	SOAP DISPENSER - VERTICAL		Yes	OWNER
J	SANITARY WIPKIN DISPOSAL		Yes	OWNER
K	ELECTRIC HAND DRYER	Yes		CONTRACTOR

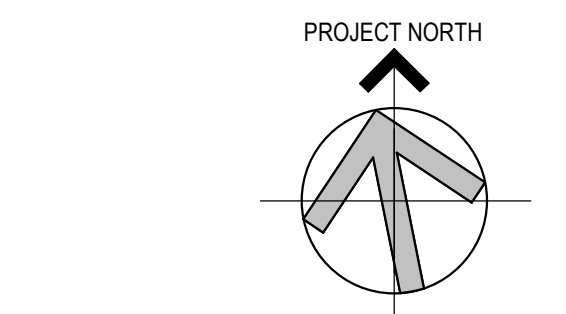
APPLIANCES			
Description	Contractor Furnished	Owner Furnished	Installation
EQ-1		Yes	OWNER
EQ-2	Yes		OWNER
EQ-3	Yes		OWNER
EQ-4	Yes		OWNER

CONSTRUCTION LEGEND	
EXISTING ITEMS	NEW CONSTRUCTION
A3-D PARTITION TAG	HATCH DENOTES MILLWORK
101 DOOR TAG	11 WINDOW TAG
	7 CORNER GUARD (CG-1)
XX	FINISH NOTATION
301	CASEWORK DESIGN SERIES NUMBER (CDS #)
24"	CABINET DEPTH (IN INCHES)
36"	COUNTER / UPPER CABINET HEIGHT (IN INCHES)
NOTE	MODIFIER NOTATION
	CABINET WIDTH (IN INCHES)
CSD-A	COUNTER SURFACE DETAIL
CASEWORK DESIGN SERIES KEY	

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Seals

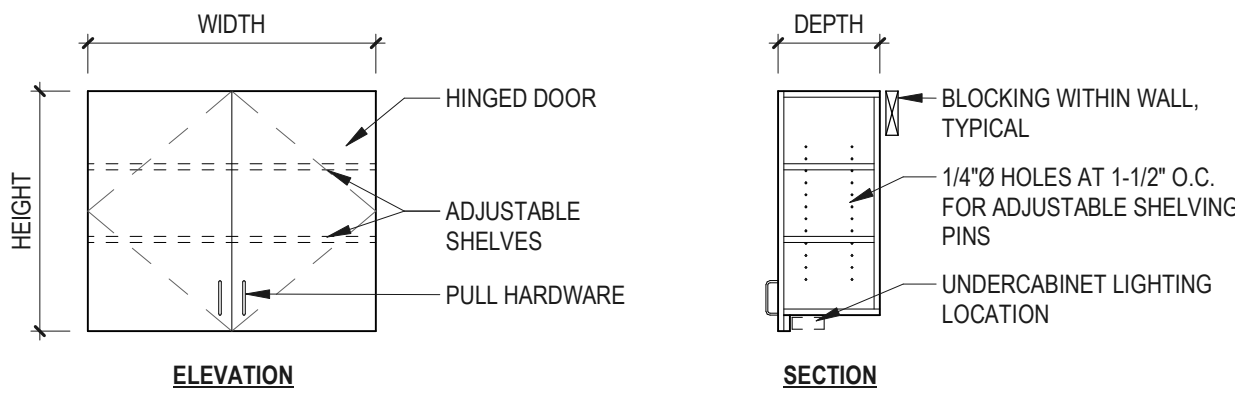
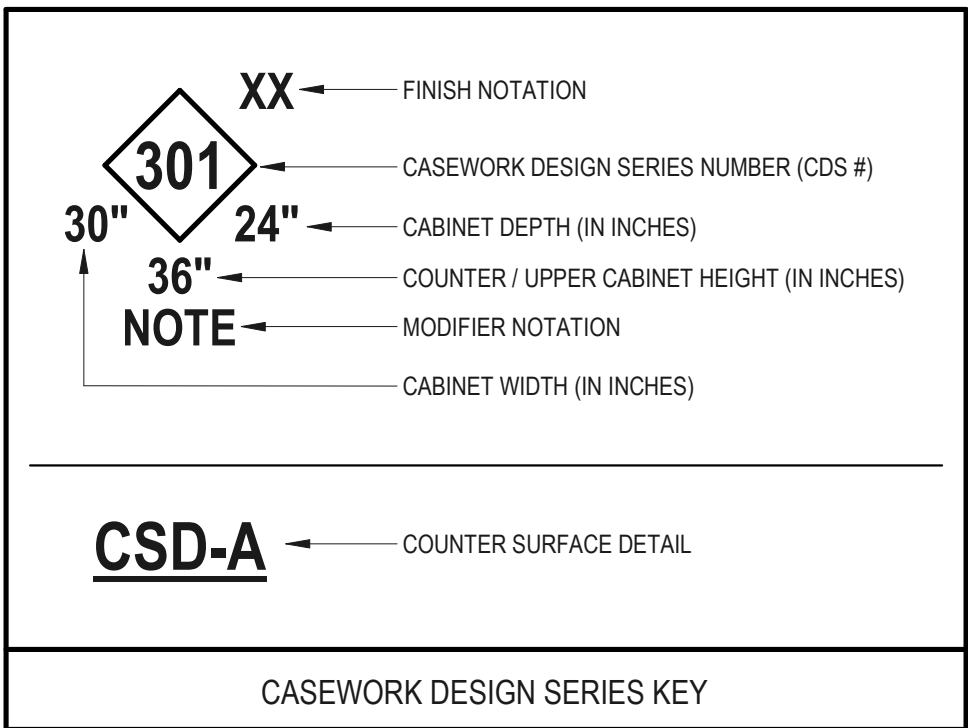
Issues / Revisions	
No.	Description
02/15/2025	SCHEMATIC DESIGN SUBMISSION
12/05/2025	DESIGN DEVELOPMENT
01/26/2026	100% CONSTRUCTION DOCUMENTS
01/29/2026	ADDENDUM 1
02/11/2026	ADDENDUM 2

Drawing Title
ENLARGED PLANS & ELEVATIONS

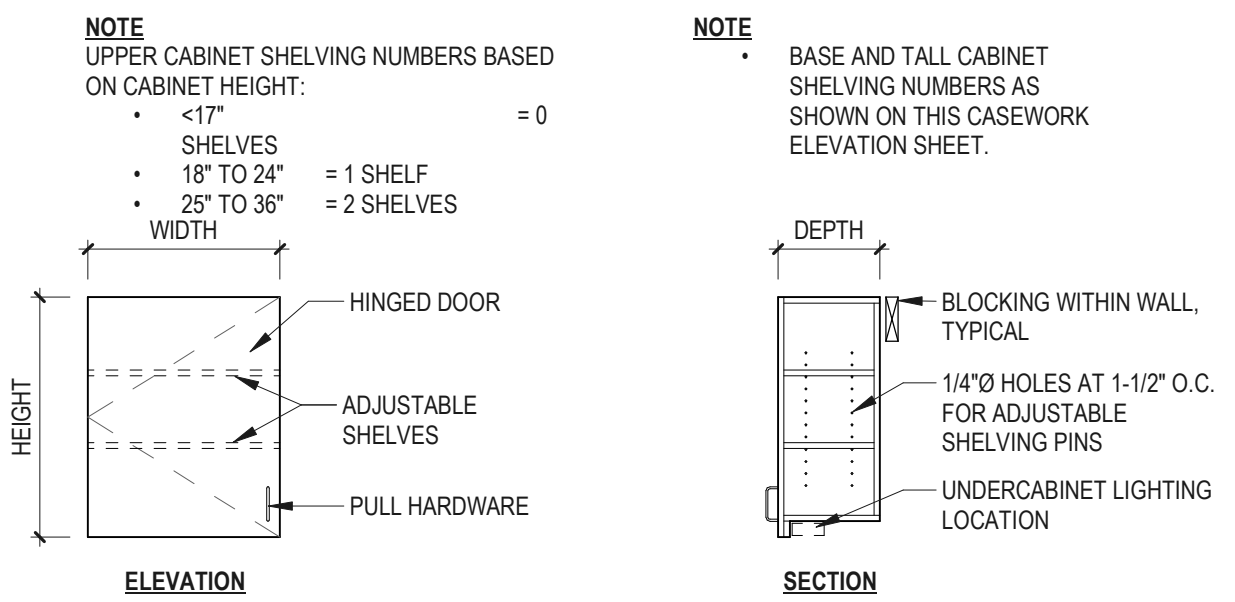
Project Manager: JH Project No: WWE02AR
Project Architect: AC Production Leader: NA
Project Designer: KM Peer Reviewer: EW
Drawing Number

A6.10

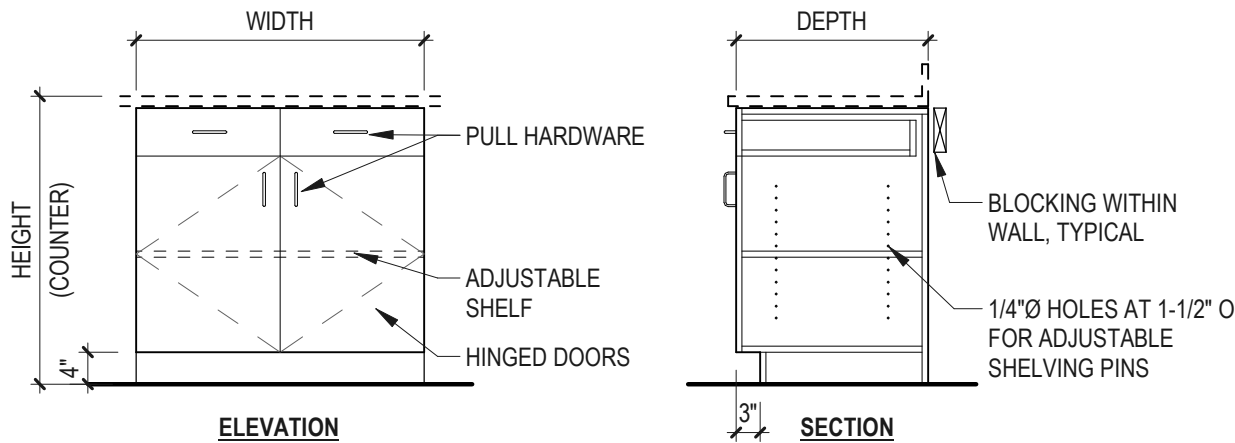
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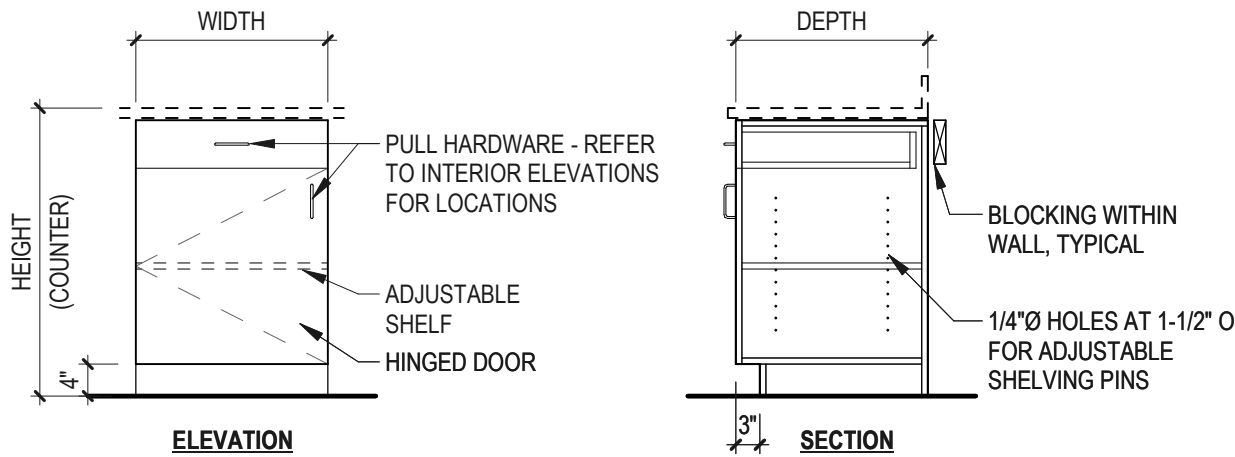
C3 CDS #302 - WALL CABINET DOUBLE DOOR
1/2" = 1'-0"



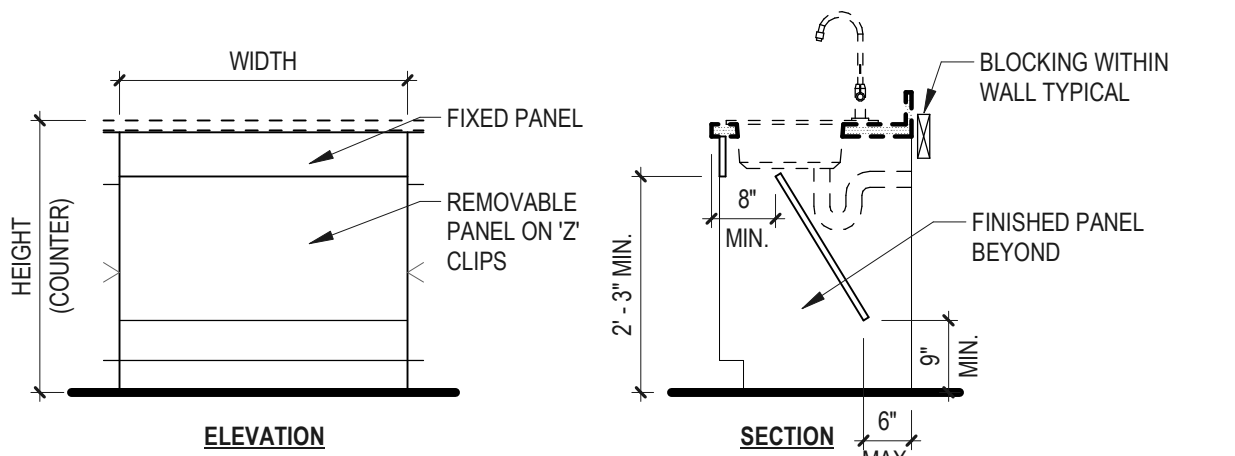
E3 CDS #301 - WALL CABINET SINGLE DOOR
1/2" = 1'-0"



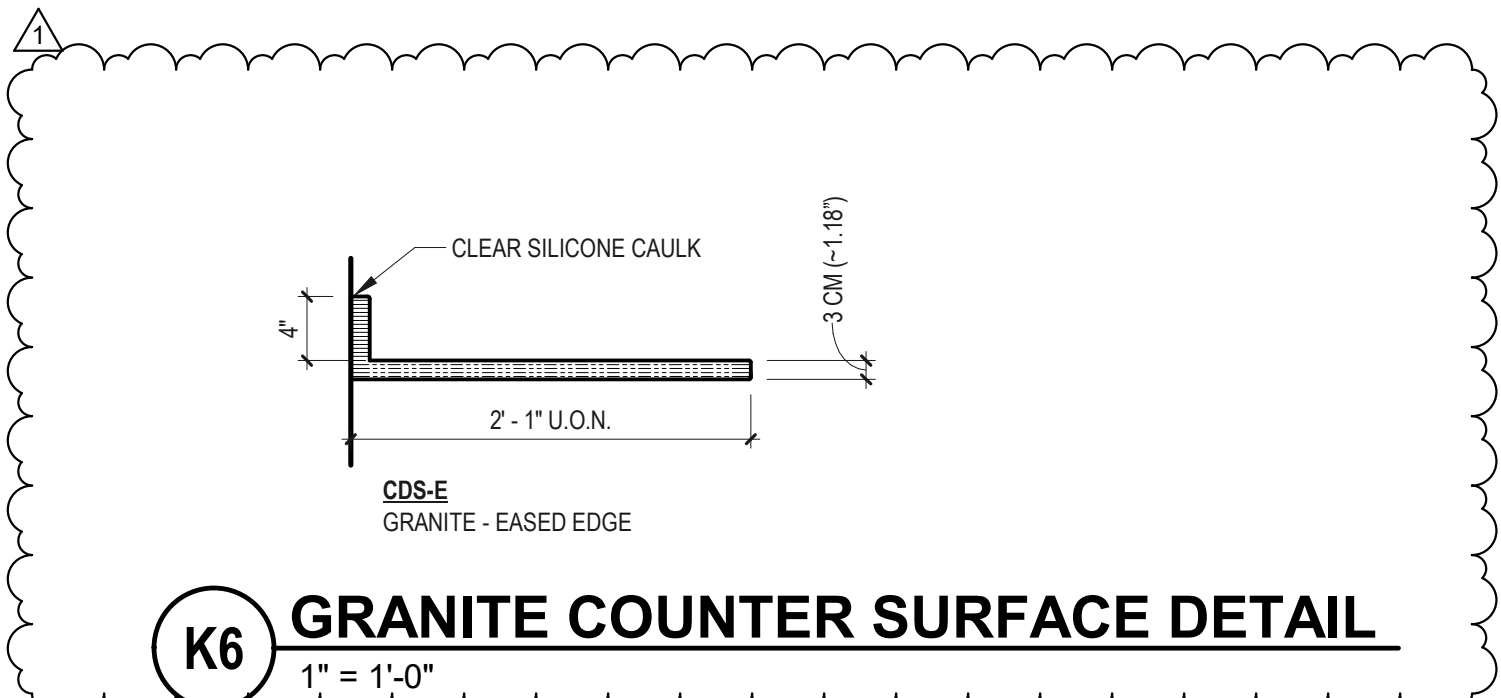
G3 CDS #222 - BASE CABINET DOUBLE DOOR, DOUBLE DRAWERS
1/2" = 1'-0"



H3 CDS #211 - BASE CABINET SINGLE DOOR, SINGLE DRAWER
1/2" = 1'-0"



K3 CDS #001 - ADA SINK VALANCE
1/2" = 1'-0"



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Seals

Issues / Revisions

No.	Date	Description
001/15/2025		SCHEMATIC DESIGN SUBMISSION
12/05/2025		DESIGN DEVELOPMENT
01/29/2026		100% CONSTRUCTION DOCUMENTS
02/11/2026		ADDENDUM 2

Drawing Title

**CASEWORK
DETAILS**

Project Manager:	JH	Project No:	WWE02AR
Project Architect:	AC	Production Leader:	NA
Project Designer:	KM	Peer Reviewer:	EW

Drawing Number

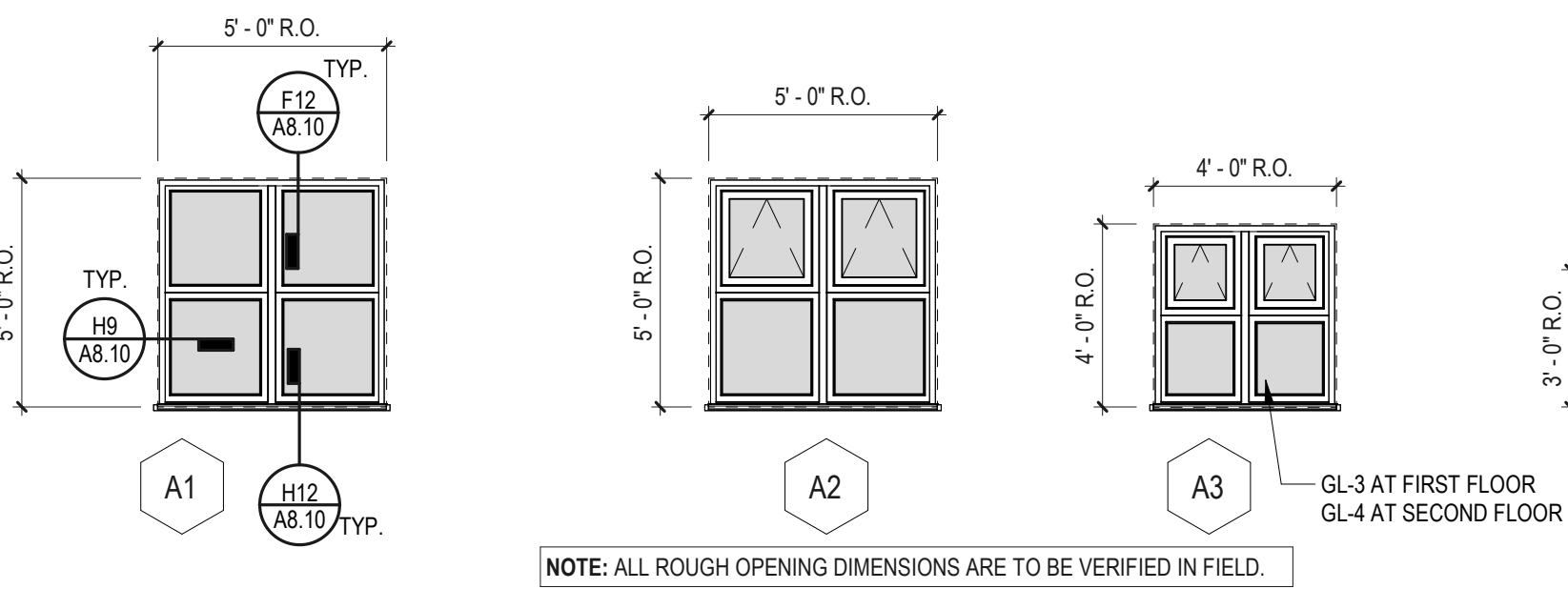
A7.20

GLAZING SCHEDULE		
TYPE	DESCRIPTION	LOCATION
GL-1	9/16" CLEAR LAMINATED GLASS	INTERIOR DOORS & WINDOWS, AS INDICATED
GL-2	3/8" CLEAR LAMINATED SECURITY/SAFETY GLASS	INTERIOR DOORS & WINDOWS, AS INDICATED
GL-3	1" LOW E CLEAR INSULATING-LAMINATED GLASS UNIT (SAFETY/SECURITY)	EXTERIOR WINDOWS UP TO 7'-0" ABOVE GRADE, TYP. U.O.N.
GL-4	1" LOW E CLEAR INSULATING GLASS UNITS	EXTERIOR WINDOWS MORE THAN 7'-0" ABOVE GRADE, TYP. U.O.N.

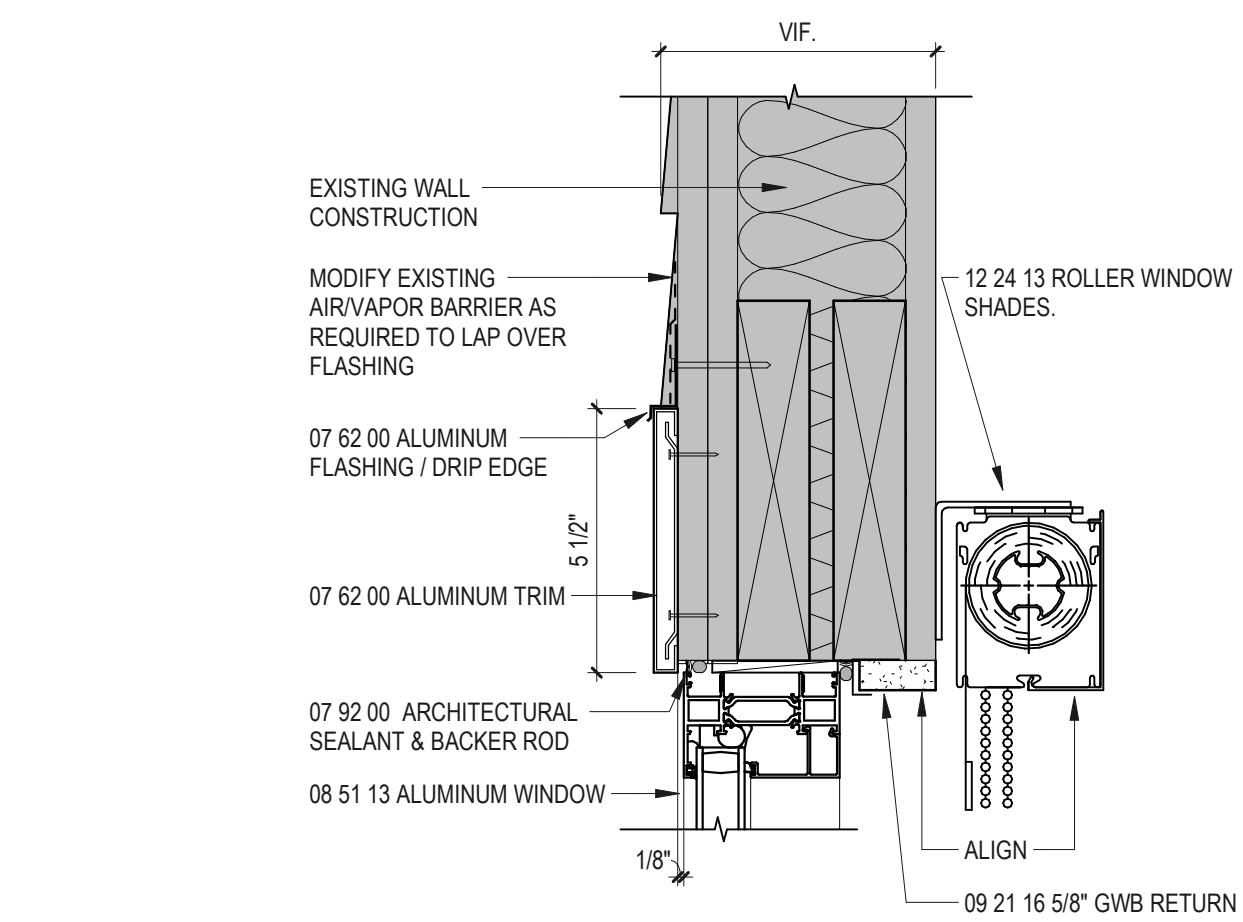
GENERAL NOTES - HARDWARE SETS	
HW SET 01. CLASSROOMS CONT. HINGES INTRUDER LOCK CYLINDERS STOP SILENCERS	HW SET 05. VESTIBULE DOORS CONT. HINGES WITH EPT PREP POWER TRANSFERS MLR C/R EXIT DEVICES EXIT ONLY PULLS CLOSERS CONCEALED OVERHEAD STOPS SWEEPS THRESHOLD POWER SUPPLY
HW SET 02. TOILETS CONT. HINGES PRIVACY LATCH CLOSER KICK AND MOP PLATES STOP SILENCERS	HW SET 06. EXISTING INTERIOR DOORS LEVER FOR LOCKSETS & LATCHSETS CYLINDRICAL LOCKS
HW SET 03. CORRIDORS CONT. HINGES SVR EXIT DEVICES WITH LEVER TRIM CLOSERS WITH STOP ARM KICK PLATES SMOKE SEALS	HW SET 07. EXTERIOR SINGLE DOORS CONT. HINGES WITH EPT PREP INTRUDER LOCK CYLINDERS STOP SILENCERS POWER SUPPLY
HW SET 04. OFFICES CONT. HINGES OFFICE LOCK STOP SILENCERS	NOTE: 1. PROVIDE HW SET 06 AT ALL EXISTING DOORS TO REMAIN, UNLESS OTHERWISE NOTED. 2. ALL LOCATIONS OF CARD READERS TO RECEIVE ELECTRIFIED HARDWARE

DOOR AND FRAME SCHEDULE - EXISTING DOORS																				NOTE: ALL INTERIOR HM DOOR FRAMES TO BE PAINTED PT-6									
ROOM NAME	DOOR NUMBER	RATINGS		DOOR										DESCRIPTION		DESCRIPTION		FRAME						HARDWARE SET	DOOR NUMBER	REMARKS			
		FIRE RATING	STC RATING	LEAF QUANTITY	SIZE		OPENING WIDTH	WIDTH - LEAF 1	WIDTH - LEAF 2	HEIGHT	TYPE - PANEL 1	TYPE - PANEL 2	MATERIAL	FINISH	INSULATED	TYPE	MATERIAL	FINISH	HEAD	JAMB	SILL	SPECIAL							
FIRST FLOOR																													
TLT.	104			1	36"	36"			84"	F		WD	ETR		ETR	HM	PT								104				
LOBBY	105			1	48"	26"	26"		80"	S	S	WD	ETR		ETR	HM	PT								105				
UTILITY/MDF	106.1			1	36"	36"			84"	F		WD	ETR		ETR	HM	PT								106.1	CARD READER			
UTILITY/MDF	106.2			1	36"	36"			84"	F		HM	ETR		ETR	HM	PT								106.2				
PRINCIPAL	107			1	36"	36"			84"	G		WD	ETR		ETR	HM	PT								107				
TLT.	108			1	36"	36"			84"	F		WD	ETR		ETR	HM	PT								108				
COMMAND CENTER	120			1	36"	36"			84"	F		HM	ETR		ETR	HM	PT								120	CARD READER, ELECTRONIC SW. KEY DEVICE			
STOR./UTIL.	120.1			1	36"	36"			84"	F		WD	ETR		ETR	HM	PT								120.1				
LOBBY	S2A			1	36"	36"			84"	N		WD	ETR		ETR	HM	PT								S2A				
MEZZ FLOOR																													
STAIR	S1B			1	36"	36"			84"	N		WD	ETR		ETR	HM	PT								S1B				
DISTRICT STORAGE/WORK	S2B			1	36"	36"			84"	N		WD	ETR		ETR	HM	PT								S2B				

DOOR AND FRAME SCHEDULE - NEW DOORS																										
ROOM NAME	DOOR NUMBER	RATINGS		DOOR								FRAME												HARDWARE SET	DOOR NUMBER	REMARKS
		FIRE RATING	STC RATING	LEAF QUANTITY	SIZE				DESCRIPTION				DESCRIPTION				DETAILS									
					OPENING WIDTH	WIDTH - LEAF 1	WIDTH - LEAF 2	HEIGHT	TYPE - PANEL 1	TYPE - PANEL 2	MATERIAL	FINISH	INSULATED	TYPE	MATERIAL	FINISH	HEAD	JAMB	SILL	SPECIAL						
NOTE: ALL INTERIOR HM DOOR FRAMES TO BE PAINTED PT-6																										
FIRST FLOOR																										
VEST.	100.1			2	72"	36"	36"	84"	FG	FG	ALUM	PRE-FIN	ALUM	ALUM	PRE-FIN						05	100.1	CARD READER, SF2, ELECTRIFIED RIM EXIT DEVICE			
VEST.	100.2			2	72"	36"	36"	84"	FG	FG	ALUM	PRE-FIN	ALUM	ALUM	PRE-FIN						05	100.2	CARD READER, SF1, ELECTRIFIED RIM EXIT DEVICE			
RECEPTION	100.3			1	36"	36"		84"	FG		WD	PRE-FIN	HM1	HM	PT						05	100.3	CARD READER, GL-2, ELECTRIFIED OFFICE LOCKSET			
LOBBY	101.1			1	36"	36"		84"	F		WD	PRE-FIN	HM1	HM	PT						03	101.1	CARD READER, ELECTRIFIED RIM EXIT DEVICE			
CORRIDOR	101.2			1	36"	36"		84"	F		WD	PRE-FIN	HM1	HM	PT						03	101.2	CARD READER, ELECTRIFIED RIM EXIT DEVICE			
LOBBY	102.1			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						04	102.1	GL-1			
CONFERENCE	102.2			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						04	102.2	GL-1			
CONFERENCE	103			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						04	103	GL-1			
NURSE	109			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						04	109	GL-1			
LOBBY	111			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						01	111	GL-1			
MULTI-PURPOSE CLASSROOM	112A			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						01	112A	GL-1			
MULTI-PURPOSE CLASSROOM	112B			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						01	112B	GL-1			
TOILET	113			1	36"	36"		84"	F		WD	PRE-FIN	HM1	HM	PT						02	113				
CORRIDOR	114			1	36"	36"		84"	F		WD	PRE-FIN	HM1	HM	PT						02	114				
HS CLASSROOM	115			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						01	115	GL-1			
CORRIDOR	116			1	36"	36"		84"	N		HM	PRE-FIN	HM1	HM	PT						07	116	CARD READER, GL-3, ELECTRIFIED RIM EXIT DEVICE			
CORRIDOR	117			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						01	117	GL-1			
REGULATION ROOM	118			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						01	118	GL-1			
HS CLASSROOM	119			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						01	119	GL-1			
CORRIDOR	121			1	36"	36"		84"	N		HM	PRE-FIN	HM1	HM	PT						07	121	CARD READER, GL-3, ELECTRIFIED RIM EXIT DEVICE			
CORRIDOR	122			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						01	122	GL-1			
MS CLASSROOM	123			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						01	123	GL-1			
CORRIDOR	124			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						01	124	GL-1			
CORRIDOR	125			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						01	125	GL-1			
MS CLASSROOM	126			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						01	126	GL-1			
CORRIDOR	127			1	36"	36"		84"	F		WD	PRE-FIN	HM1	HM	PT						02	127				
TOILET	128			1	36"	36"		84"	F		WD	PRE-FIN	HM1	HM	PT						02	128				
CORRIDOR	129			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						01	129	GL-1			
TAKE SPACE	130			1	36"	36"		84"	N		WD	PRE-FIN	HM1	HM	PT						01	130	GL-1			
STAIR	S1A			1	36"	36"		84"	N		HM	PRE-FIN	HM1	HM	PT						07	S1A	DOOR CONTACT, MECHANICAL RIM EXIT DEVICE			
MEZZ FLOOR																										
DISTRICT STORAGE/WORK	200			2	48"	24"	24"	84"	L	L	WD	PRE-FIN	HM1	HM	PT						04	200	CARD READER, CYLINDRICAL ELECTRIFIED LOCK			

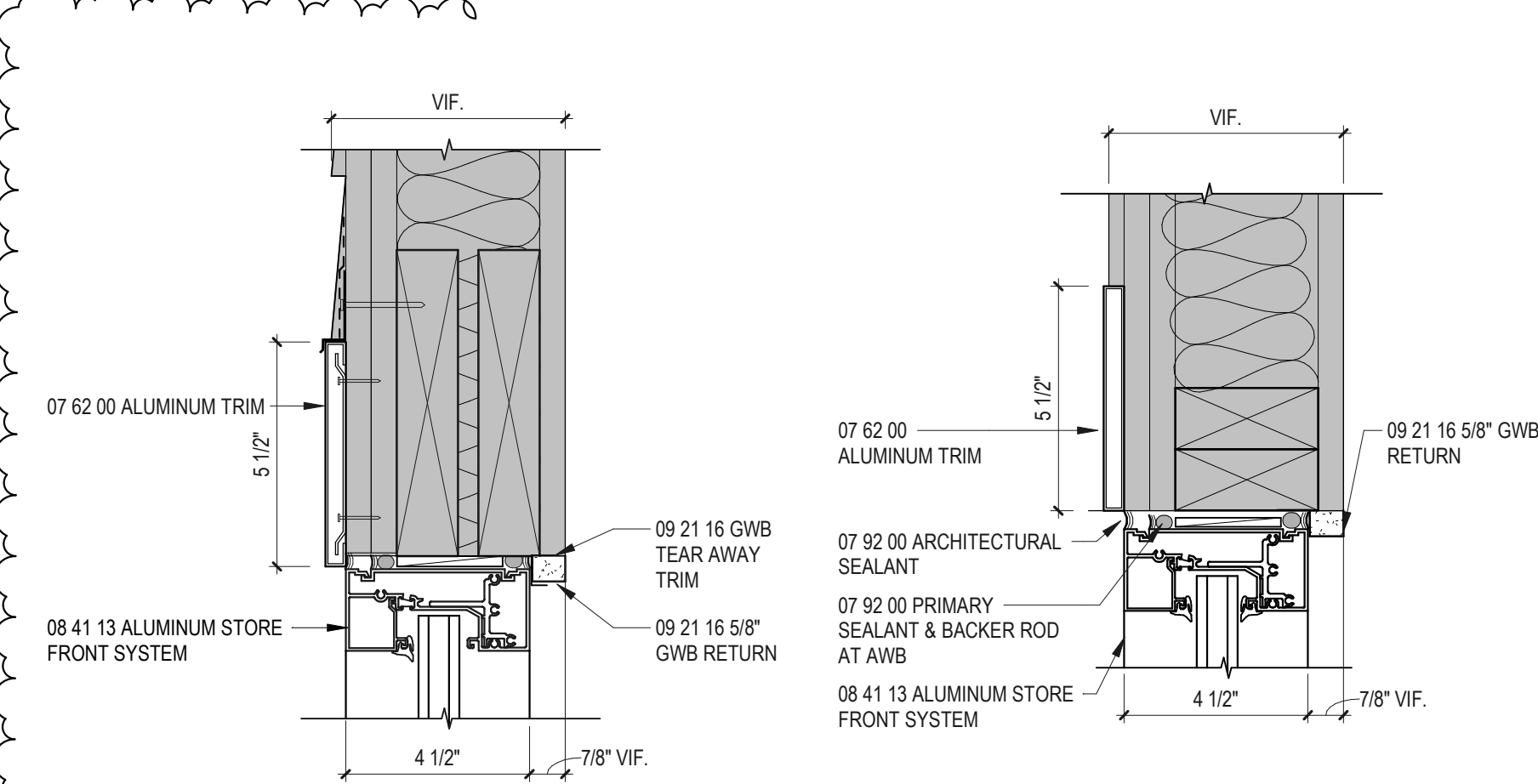


WINDOW ELEVATIONS



ALUMINUM WINDOW HEAD DETAIL AT EXISTING WALL

F12



SF HEAD AT EXIST. INT. PARTITION

D9

SF JAMB AT EXIST. INT. PARTITION

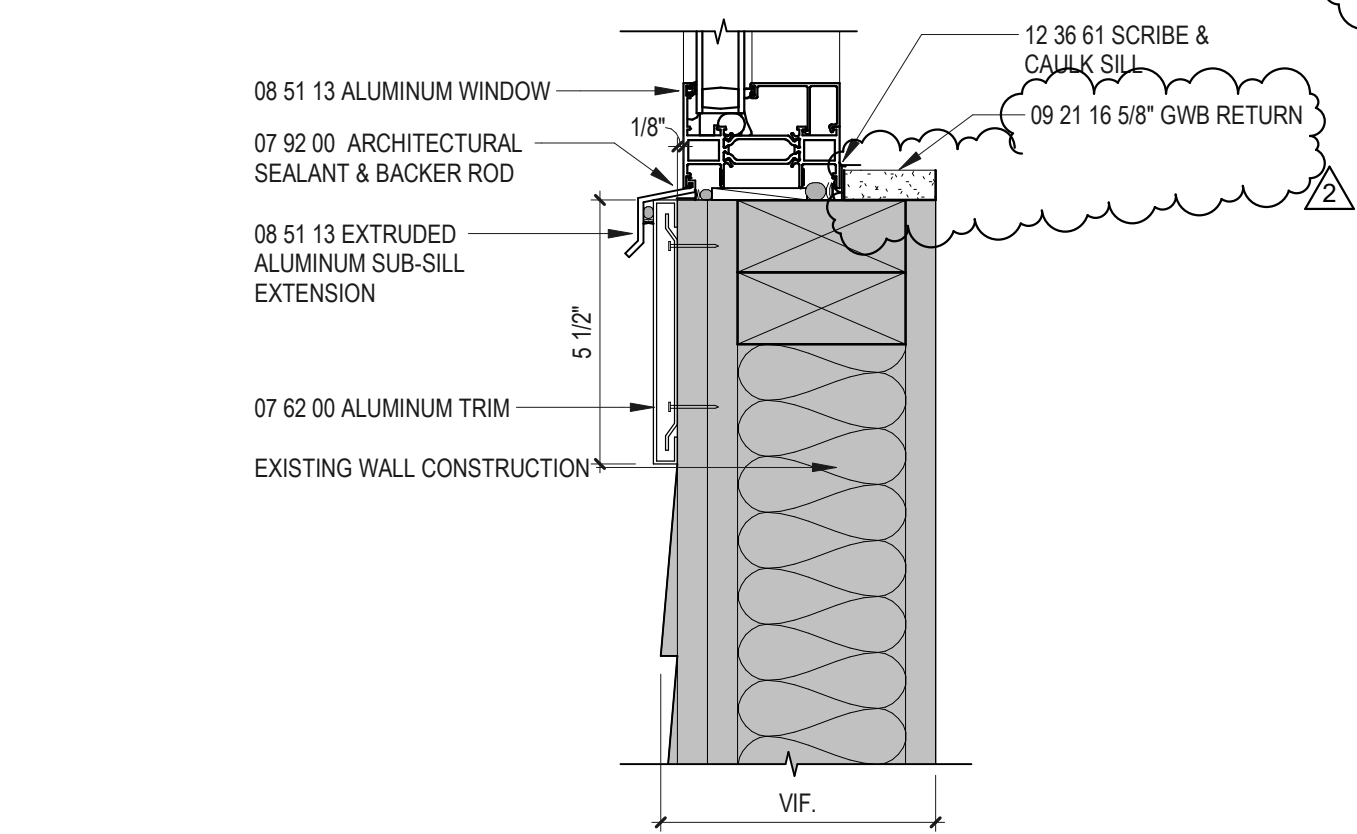
D7

SF HEAD DETAIL AT EXISTING EXT. WALL

F10

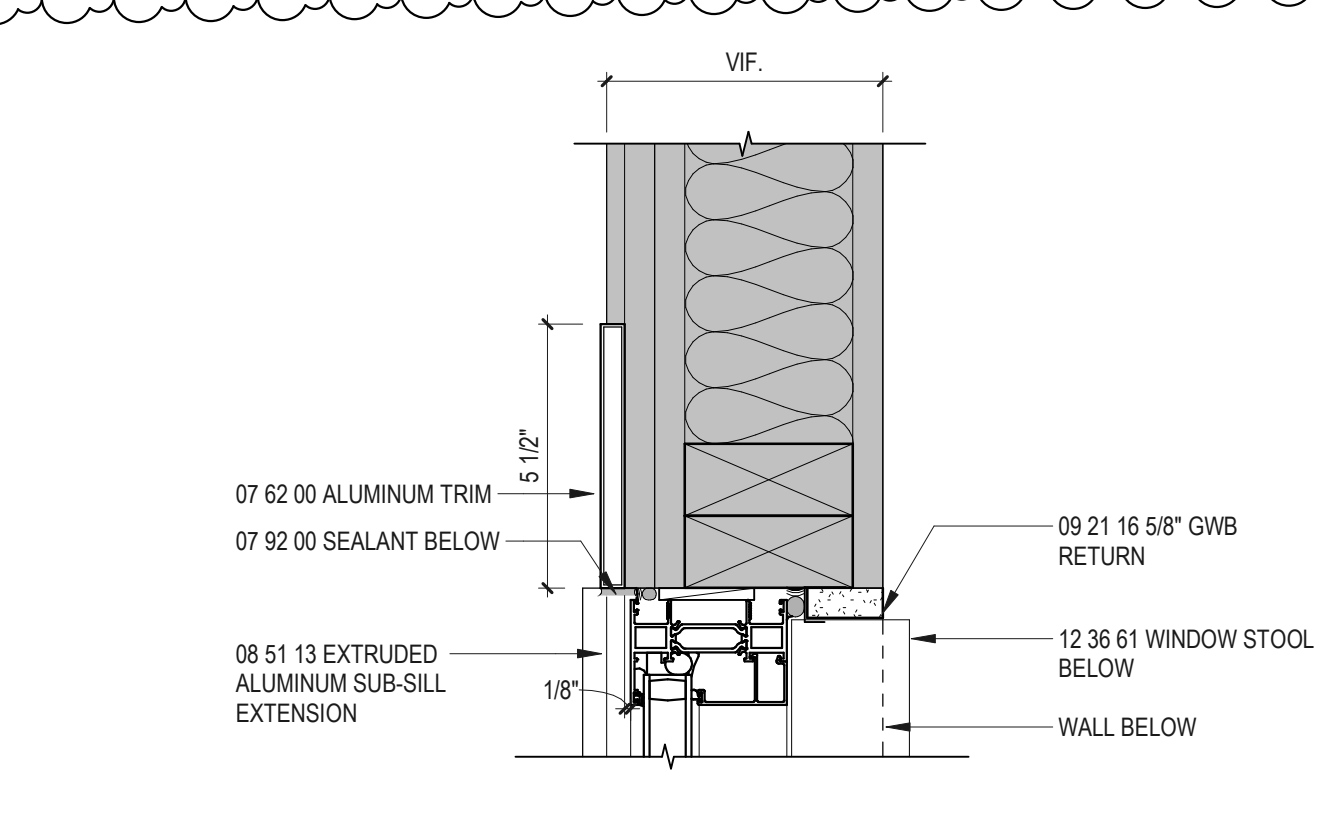
SF JAMB DETAIL AT EXISTING EXT. WALL

F8



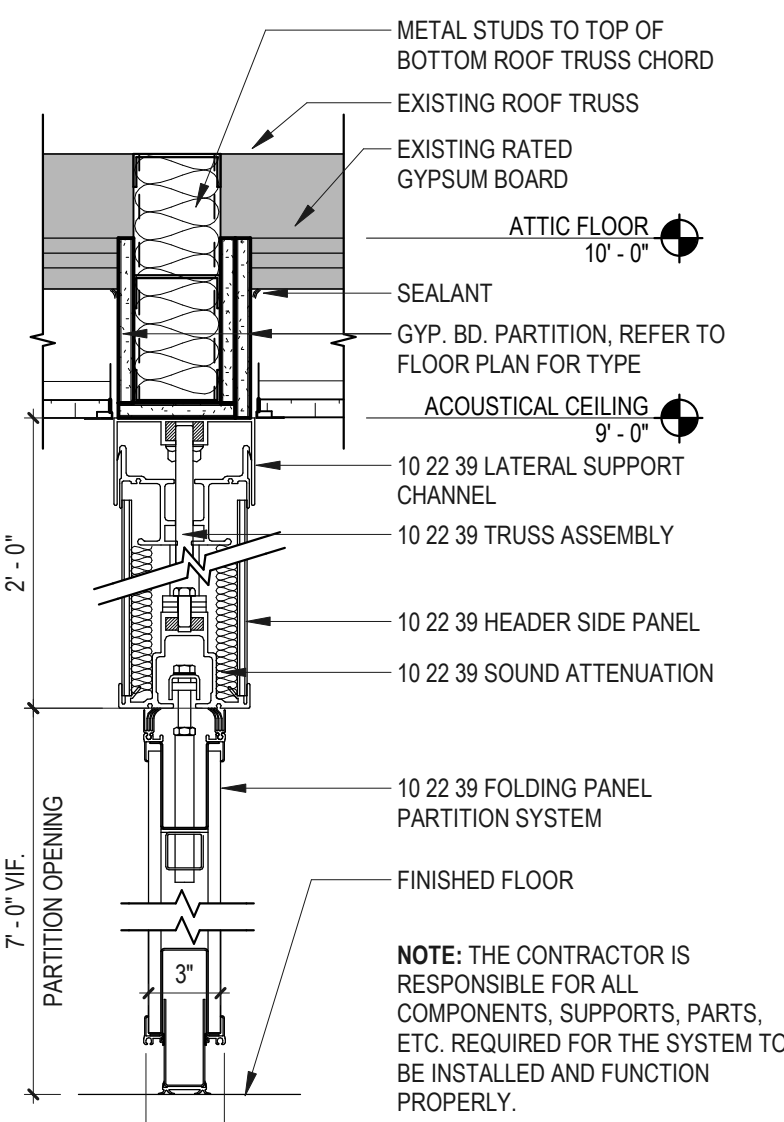
ALUMINUM WINDOW SILL DETAIL AT EXISTING WALL

H12



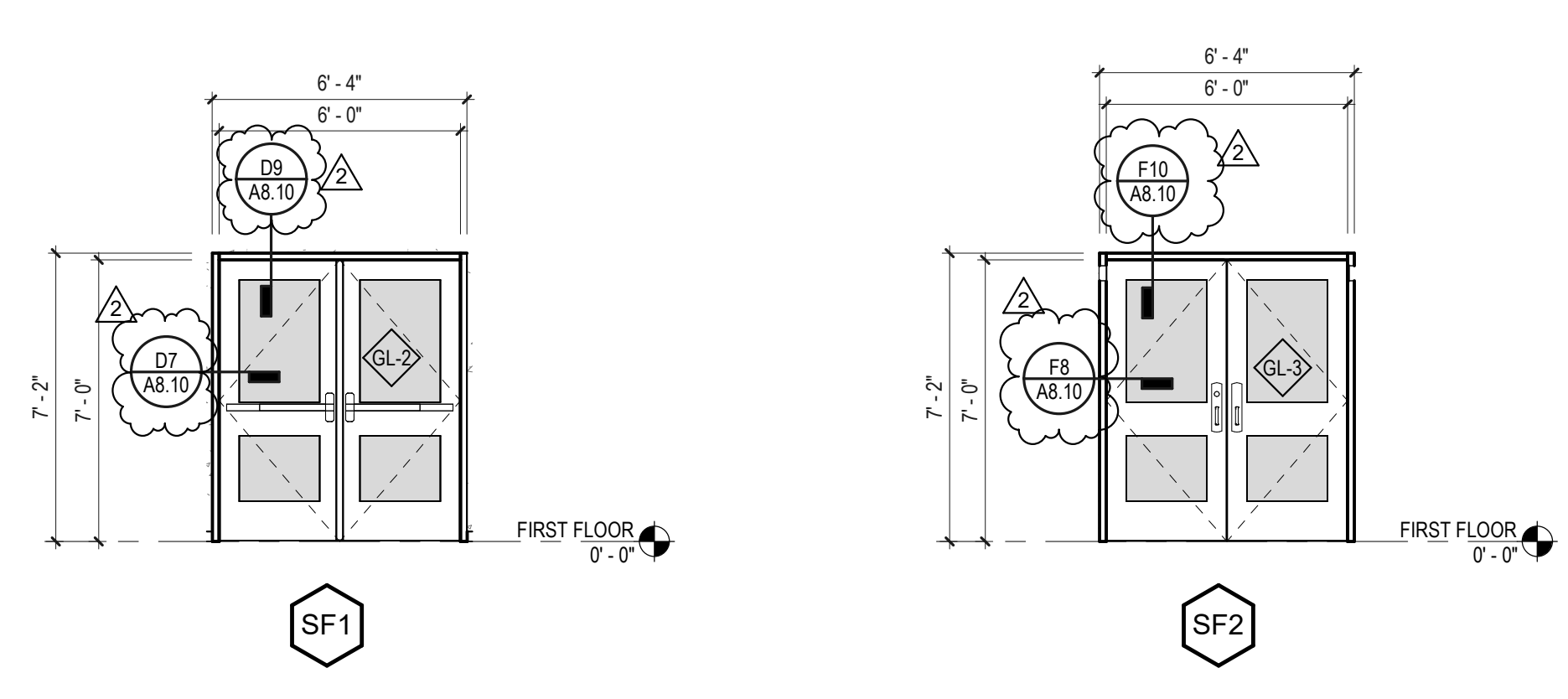
ALUMINUM WINDOW JAMB DETAIL AT EXISTING WALL

H9



FOLDING PANEL PARTITION SECTION

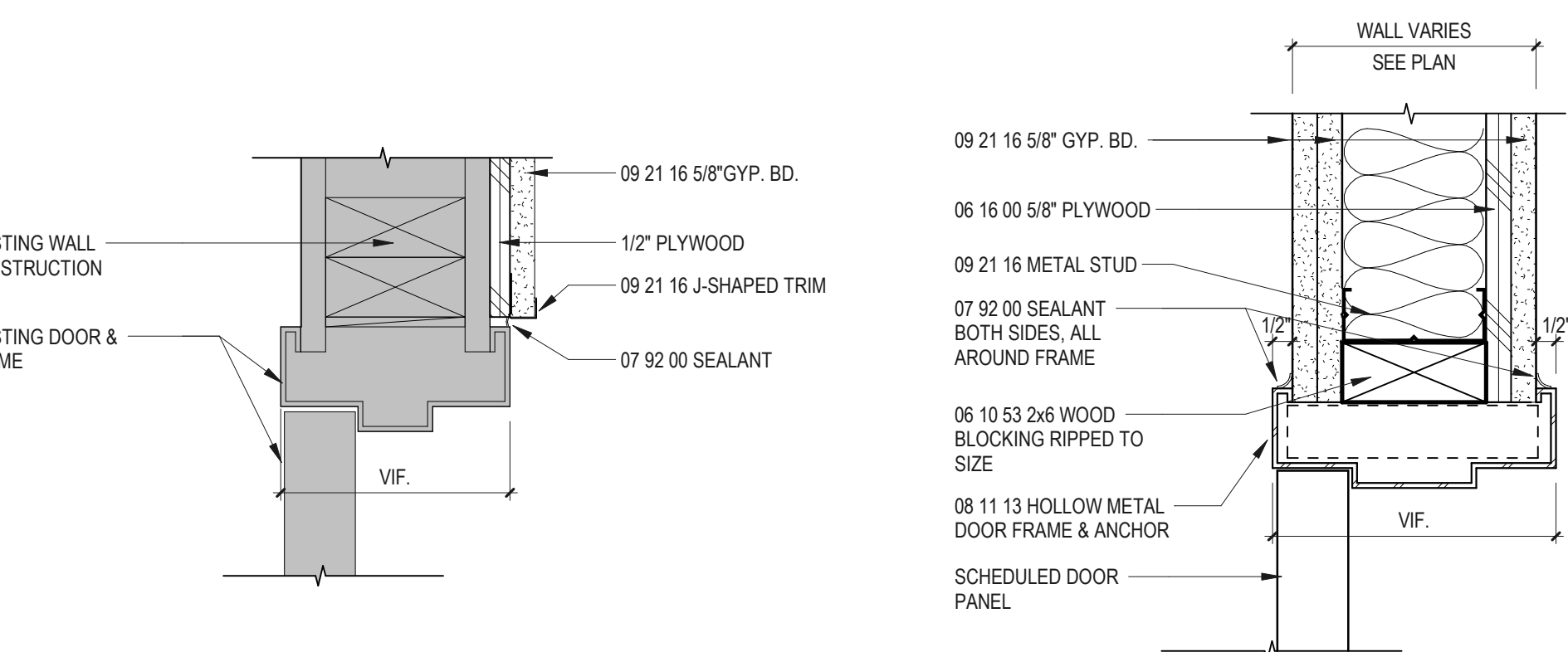
H6



INTERIOR AND EXTERIOR STOREFRONT SYSTEM

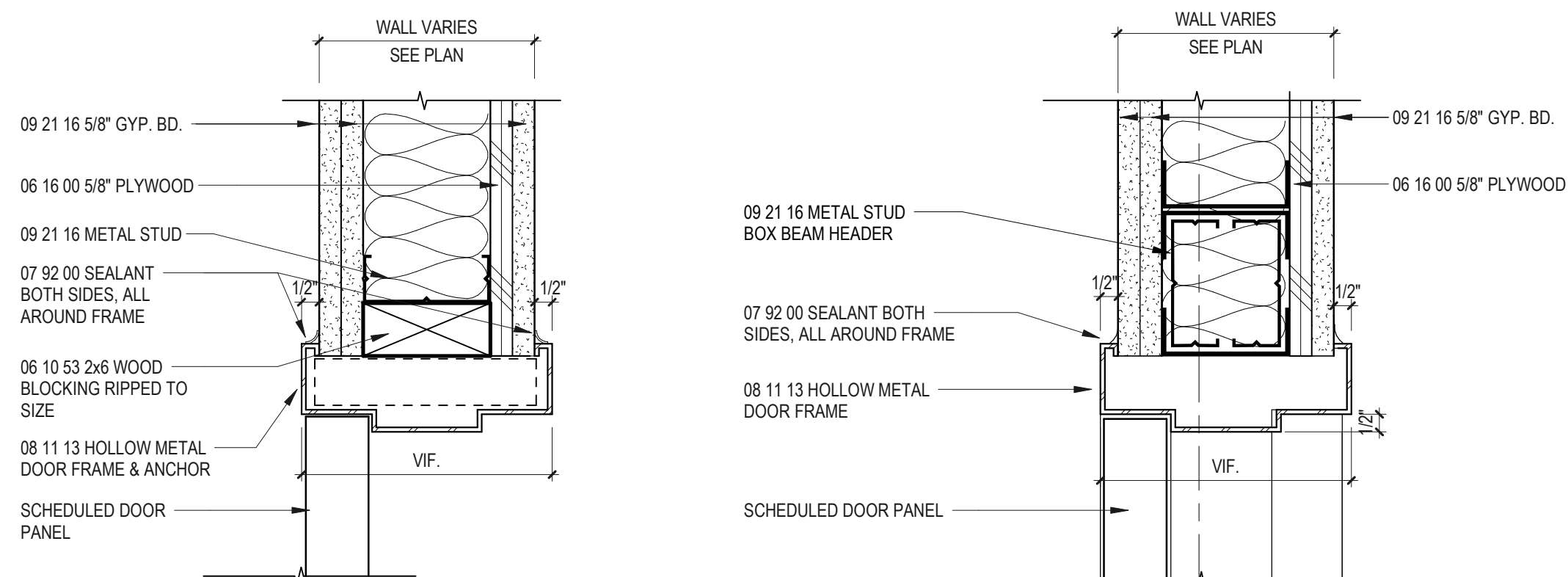
SF1

SF2



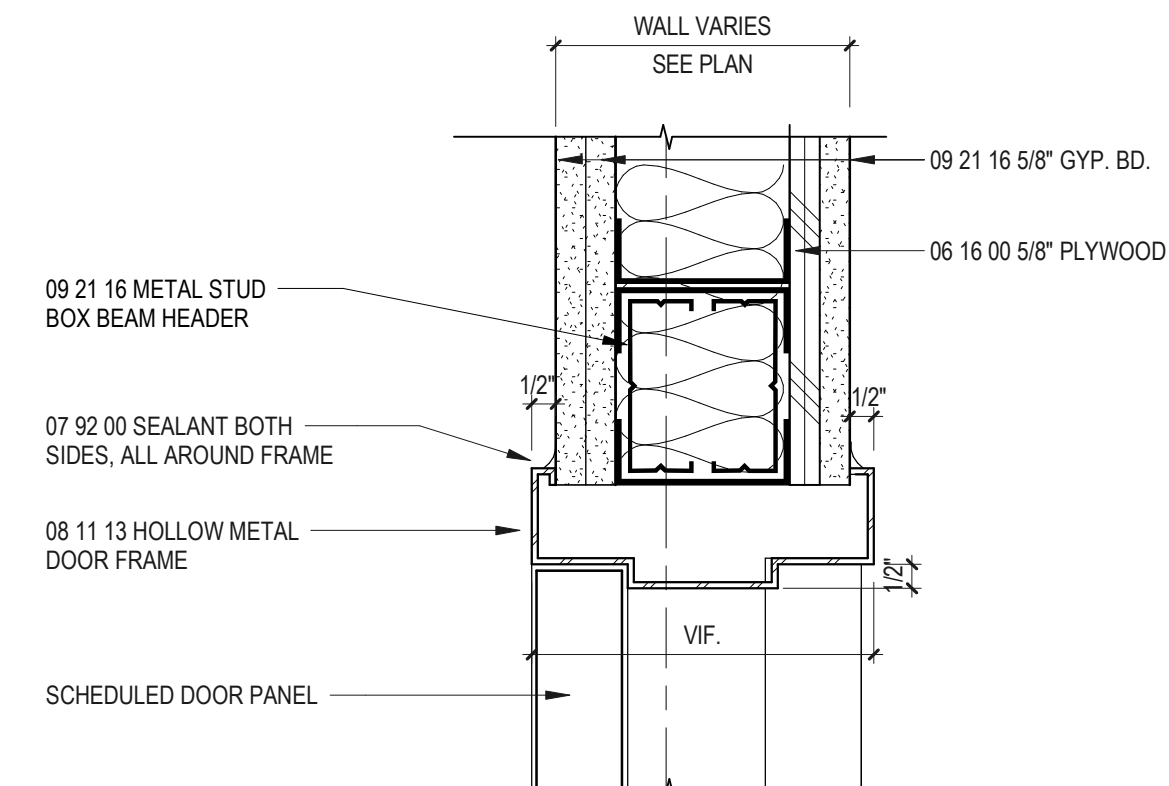
EXISTING METAL DOOR JAMB

K12



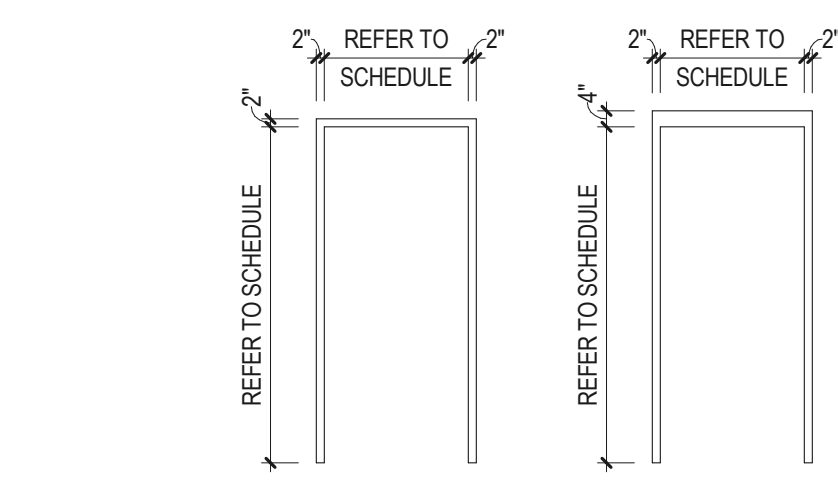
HOLLOW METAL DOOR JAMB GYP. BD. PARTITION

K10



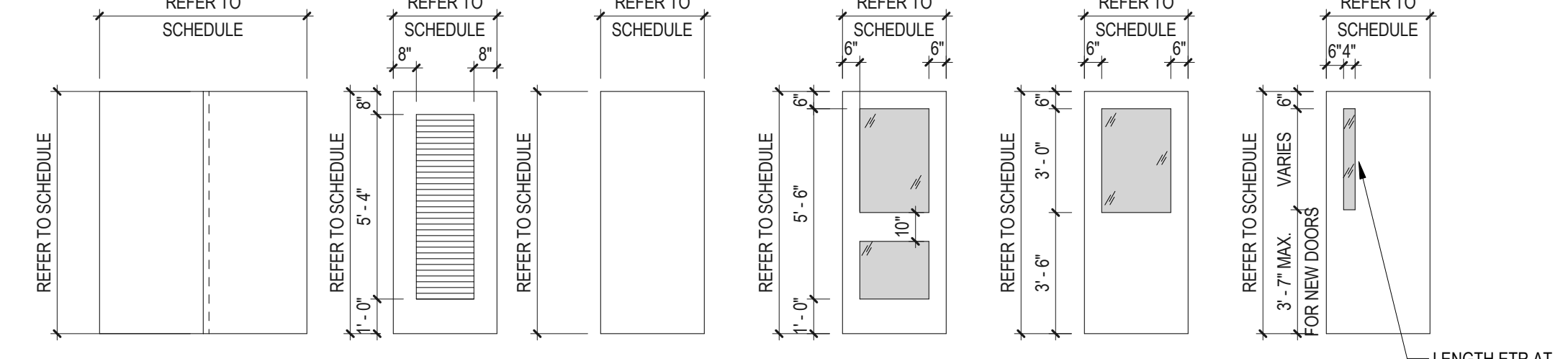
HOLLOW METAL DOOR JAMB GYP. BD. PARTITION

K8



HOLLOW METAL FRAME TYPES

K6



DOOR TYPES

K4

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Client/ Contractor

**WEST WARWICK
PUBLIC SCHOOLS**

10 Harris Ave
West Warwick, RI 02893

Project

30 PAYAN ST

30 PAYAN STREET
WEST WARWICK, RI 02893

Seals

Issues / Revisions	
No.	Description
1	DESIGN DEVELOPMENT
2	100% CONSTRUCTION DOCUMENTS
1	ADDENDUM 1
2	ADDENDUM 2

Drawing Title

**DOOR &
WINDOW
SCHEDULES,
ELEVATIONS
AND DETAILS**

Project Manager: JH Project No: WWEIG2AR

Project Architect: AC Production Leader: NA

Project Designer: KM Peer Reviewer: EW

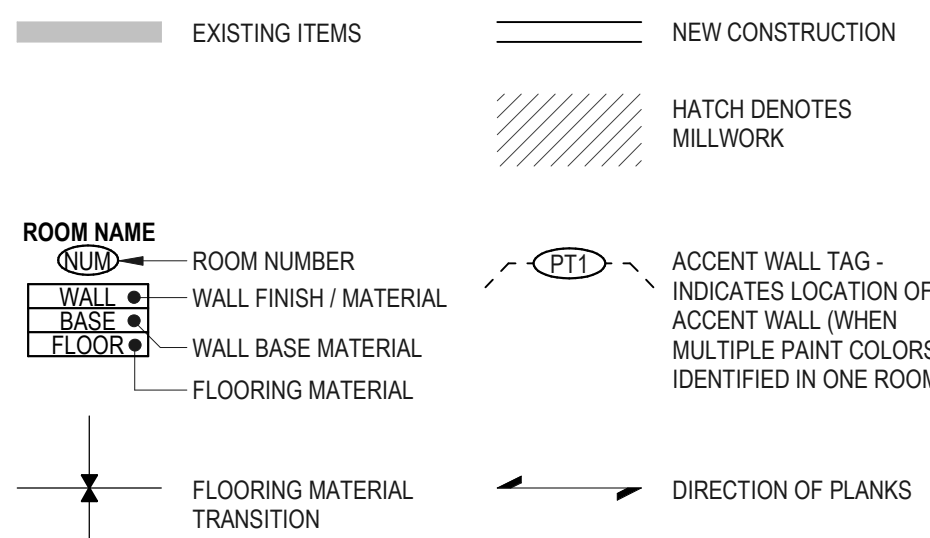
Drawing Number

A8.10

GENERAL NOTES - FINISHES

1. FOR ROOMS WITH MULTIPLE WALL FINISHES CALLED OUT REFER TO INTERIOR ELEVATIONS. FOR ROOMS WITH MULTIPLE FLOORING FINISHES CALLED OUT REFER TO FINISH DETAIL PLANS.
2. FOR INTERIOR PAINT FINISHES:
- ALL INTERIOR WALLS TO BE EGGSHELL FINISH, UNLESS EPOXY FINISH IS NOTED.
 - ALL DOOR AND WINDOW FRAMES TO BE SEMI-GLOSS FINISH.
 - ALL GYPSUM BOARD CEILINGS TO BE PAINTED TO BE FLAT FINISH.
 - ALL PAINTED METAL TO BE SEMI-GLOSS FINISH, UNLESS EPOXY FINISH IS NOTED.
3. ALL EXPOSED COLUMNS THAT ARE NOT INCORPORATED IN A WALL ARE TO BE PAINTED PT-1, UNLESS OTHERWISE NOTED. EXPOSED STRUCTURE THAT IS INCORPORATED IN A WALL IS TO BE PAINTED TO MATCH ADJACENT WALL.
4. FLOOR FINISHES TO EXTEND UNDER CASEWORK AND SPECIALTY/FIREMATIC EQUIPMENT.
5. INSTALL WF-2 ON INSIDE FACE OF ALL EXTERIOR WINDOWS.

FINISHES LEGEND



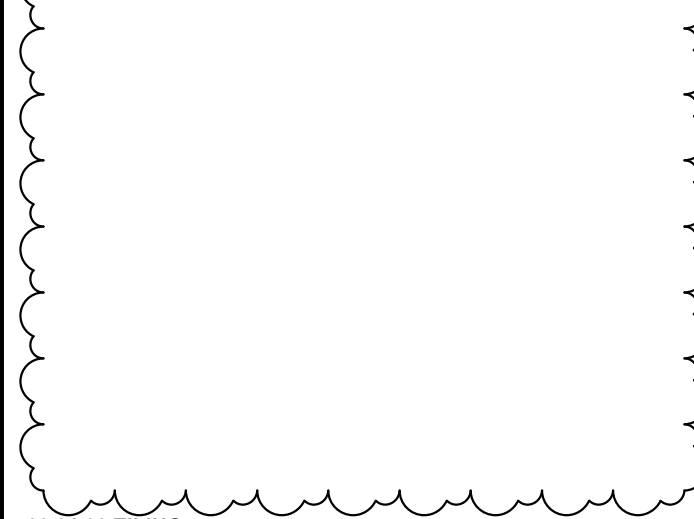
MATERIALS LIST

06 49 23 INTERIOR ARCHITECTURAL WOODWORK

PL-1 ITEM: PLASTIC LAMINATE
MFR: WILSONART
COLOR: KENSINGTON MAPLE
INSTALL: GRAIN TO RUN VERTICALLY
NOTE: FOR USE ON ALL VERTICAL MILLWORK, U.O.N.

08 14 16 FLUSH WOOD DOORS

WD-1 ITEM: WOOD DOORS
MFR: MASONITE ARCHITECTURAL
SERIES: TBD
PRODUCT: SOLID CORE WOOD DOORS
SPECIES: MAPLE
CUT: PLAIN-SLICED
STAIN: TBD, ARCHITECT TO SELECT FROM FULL RANGE OF MANUFACTURER'S STANDARD STAIN OPTIONS



09 31 00 TILING

FT-1 ITEM: MOSAIC FLOOR TILE W/ JUTE BACKER
MFR: AMERICAN OLEAN
PRODUCT: UNGLAZED MOSAIC
SIZE: 2" HEXAGON MOSAIC
COLOR: LIGHT SMOKE A43
FINISH: MATTE
THICKNESS: 1/4"

TE-2 ITEM: COVE SHAPE TILE EDGE
MFR: SCHLUTER
PRODUCT: DILEX-HKS V2A U (TBD) / O (TBD) (TBD)
SIZE: TBD, USE MFR'S RECOMMENDATION
MATERIAL: STAINLESS STEEL
FINISH: STAINLESS STEEL 304
INSTALL: INSTALLER TO USE ALL MFR'S COORDINATING CORNER/TRIM/EDGE ACCESSORIES AS REQUIRED (EX. OUTSIDE CORNER (A/EHK 2 R18), INSIDE CORNER (VEHK 2 R18), CONNECTOR (A/EHK 2 R18), END CAP (A/EHK) AT ALL JOINTS, CORNERS, ENDS. DO NOT MITER.

WT-1 ITEM: CERAMIC WALL TILE
MFR: AMERICAN OLEAN
PRODUCT: COLOR STORY WALL
SIZE: 4" x 12"
COLOR: CALM 0035
FINISH: GLOSSY
THICKNESS: 3/8" (9/16")
GROUT: 1/16" COLOR TBD
INSTALL: TO BE INSTALLED AS RUNNING BOND TOP ROW OF TILE TO BE BULLNOSE (S44CSM001) 4" x 12", BULLNOSE ON 12" SIDE

SHT-1 ITEM: VINYL SHEET FLOORING
MFR: A/H CONTRACT
PRODUCT: MIXED & VARIEGATED
COLOR: 1HG2M012 - CITY DWELLER
SIZE: 78 1/4" W. ROLL
NOTE: TO BE ORIENTED IN ROOM SUCH THAT NO SEAMS ARE REQUIRED

09 65 19 VINYL COMPOSITION TILE (VCT)

VCT-1 ITEM: VINYL COMPOSITION TILE
MFR: ARMSTRONG FLOORING
PRODUCT: PREMIUM EXCELOX CROWN TEXTURE
COLOR: TBD
SIZE: 12" x 12"
NOTE: FIELD COLOR

VCT-2 ITEM: VINYL COMPOSITION TILE
MFR: ARMSTRONG FLOORING
PRODUCT: PREMIUM EXCELOX GROWN TEXTURE
COLOR: TBD
SIZE: 12" x 12"
NOTE: MS ACCENT COLOR

VCT-3 ITEM: VINYL COMPOSITION TILE
MFR: ARMSTRONG FLOORING
PRODUCT: PREMIUM EXCELOX CROWN TEXTURE
COLOR: TBD
SIZE: 12" x 12"
NOTE: HS ACCENT COLOR

09 51 13 ACUSTICAL PANEL CEILINGS

APC-1 ITEM: ACUSTIC PANEL CEILING
MFR: ARMSTRONG COMMERCIAL
PRODUCT: ULTIMA HIGH NRC
STYLE: ULTIMA HEALTH ZONE HIGH NRC
COLOR: 24" x 48" x 7/8"
ITEM NO.: 1943
COLOR: WHITE
GRID MFR: ARMSTRONG
GRID COLOR: WHITE

APC-2 ITEM: ACUSTIC PANEL CEILING
MFR: ARMSTRONG COMMERCIAL
PRODUCT: ULTIMA HEALTH ZONE HIGH NRC
STYLE: ULTIMA HEALTH ZONE HIGH NRC
COLOR: 24" x 48" x 7/8"
ITEM NO.: 1446
COLOR: WHITE
GRID MFR: ARMSTRONG
GRID COLOR: WHITE

APM-1 ITEM: ACUSTIC CLG TRANSITION MOLDING
MFR: ARMSTRONG
PRODUCT: STEEL "F" TRANSITION
ITEM NO.: #265
COLOR: WHITE
FINISH: PAINT TO MATCH VERTICAL SOFFIT

09 65 13 RESILIENT BASE AND ACCESSORIES

WB-1 ITEM: RUBBER WALL BASE
MFR: TARKETT
PRODUCT: TRADITIONAL DURACOVE 1/8"
PROFILE: THERMOPLASTIC RUBBER (TYPE TP)
COLOR: 471 COVE
SIZE: 121 CEMENT CB
120L ROLL

RT-1 ITEM: RUBBER FLOOR TILE
MFR: TARKETT
PRODUCT: RUBBER FLOOR TILE
SERIES: SOLID COLOR
TEXTURE: HAMMERED
COLOR: TBD
SIZE: 24" x 24"
LOCATION: ALL STAIRWELL LANDINGS & RAMPS

RT-2 ITEM: RUBBER FITNESS FLOOR TILE
MFR: TARKETT
PRODUCT: REPLAY COMMOTION
SERIES: INTERLOCKING COMMOTION LOOSE-LAY TILE
COLOR: 522 SANDUSKY
SIZE: 24" x 24"
THICKNESS: 3/8" (9.5 mm)

RST-1 ITEM: RUBBER STAIR TREAD & RISER
MFR: TARKETT
PRODUCT: ANGLE FIT STAIR TRADS WITH INTEGRATED RISERS
SERIES: SOLID COLOR
TEXTURE: HAMMERED
COLOR: TBD
WIDTH: VARIES (RUN FULL WIDTH OF STAIR, NO SEAMS)
PRODUCT: VI STRIP: YES (GRIT TAPE, COLOR TBD)

09 65 16 RESILIENT SHEET VINYL FLOORING

SHT-1 ITEM: VINYL SHEET FLOORING
MFR: A/H CONTRACT
PRODUCT: MIXED & VARIEGATED
COLOR: 1HG2M012 - CITY DWELLER
SIZE: 78 1/4" W. ROLL
NOTE: TO BE ORIENTED IN ROOM SUCH THAT NO SEAMS ARE REQUIRED

09 65 19 VINYL COMPOSITION TILE (VCT)

VCT-1 ITEM: VINYL COMPOSITION TILE
MFR: ARMSTRONG FLOORING
PRODUCT: PREMIUM EXCELOX CROWN TEXTURE
COLOR: TBD
SIZE: 12" x 12"
NOTE: FIELD COLOR

VCT-2 ITEM: VINYL COMPOSITION TILE
MFR: ARMSTRONG FLOORING
PRODUCT: PREMIUM EXCELOX GROWN TEXTURE
COLOR: TBD
SIZE: 12" x 12"
NOTE: MS ACCENT COLOR

VCT-3 ITEM: VINYL COMPOSITION TILE
MFR: ARMSTRONG FLOORING
PRODUCT: PREMIUM EXCELOX CROWN TEXTURE
COLOR: TBD
SIZE: 12" x 12"
NOTE: HS ACCENT COLOR

09 68 13 TILE CARPETING

CPT-1 ITEM: MODULAR CARPET TILE
MFR: MOHAWK GROUP
COLLECTION: ART STYLE
STYLE: SHARED PATH BT429
COLOR: 924 PLATINUM
SIZE: 12" x 36"
INSTALL: BRICK ASHLAR

CPT-2 ITEM: MODULAR CARPET TILE
MFR: MOHAWK GROUP
COLLECTION: ART STYLE
STYLE: DISRUPTIVE PATH BT430
COLOR: 915 BLUE DUSK
SIZE: 12" x 36"
INSTALL: BRICK ASHLAR

CPT-3 ITEM: MODULAR CARPET TILE
MFR: MOHAWK GROUP
COLLECTION: ART STYLE
STYLE: DISRUPTIVE PATH BT430
COLOR: 916 LIME RUSH
SIZE: 12" x 36"
INSTALL: BRICK ASHLAR

09 91 00 PAINTING

PT-1 ITEM: PAINT
MFR: BENJAMIN MOORE
PRODUCT: SCUFF-X
COLOR: TO MATCH
SHERWIN WILLIAM
7035 AESTHETIC WHITE
GENERAL WALL COLOR

PT-2A ITEM: PAINT
MFR: BENJAMIN MOORE
PRODUCT: SCUFF-X
COLOR: TO MATCH
SHERWIN WILLIAM
6708 SPRINGTIME
MS ACCENT COLOR LIGHT

PT-2B ITEM: PAINT
MFR: BENJAMIN MOORE
PRODUCT: SCUFF-X
COLOR: TO MATCH
SHERWIN WILLIAM
6708 SPRINGTIME
MS ACCENT COLOR LIGHT

PT-3A ITEM: PAINT
MFR: BENJAMIN MOORE
PRODUCT: SCUFF-X
COLOR: TO MATCH
SHERWIN WILLIAM
6708 SPRINGTIME
MS ACCENT COLOR LIGHT

PT-3B ITEM: PAINT
MFR: BENJAMIN MOORE
PRODUCT: SCUFF-X
COLOR: TO MATCH
SHERWIN WILLIAM
6708 SPRINGTIME
MS ACCENT COLOR LIGHT

PT-4 ITEM: PAINT
MFR: BENJAMIN MOORE
PRODUCT: SCUFF-X
COLOR: TO MATCH
SHERWIN WILLIAM
6708 SPRINGTIME
MS ACCENT COLOR LIGHT

PT-5 ITEM: WRITABLE WALL PAINT
MFR: WOLF GORDON
PRODUCT: CLEAR
COLOR: CLEAR
INSTALL: AS TOP COAT OVER PAINT
NOTE: LEVEL 5 DRYWALL FINISH REQUIRED

PT-6 ITEM: PAINT
MFR: BENJAMIN MOORE
PRODUCT: SCUFF-X
COLOR: TO MATCH
SHERWIN WILLIAM
7045 INTELLECTUAL GRAY
SHARED SPACE ACCENT COLOR

SC-1 ITEM: CONCRETE SEALER
MFR: SHERWIN WILLIAMS
PRODUCT: ARMORSEAL 8100
ITEM # CT315
COLOR: TBD

10 11 00 VISUAL DISPLAY SURFACES

VD-1 ITEM: TACKLESS DISPLAY RAIL
MFR: MY WHITEBOARDS
PRODUCT: TACKLESS PAPER DISPLAY RAIL
MATERIAL: ALUMINUM
SKU: EE-WRAIL-HD-06
INSTALL: SCREWS
SIZE: 6' LONG

10 21 23 CUBICLES

FAB-1 ITEM: FABRIC PRIVACY CURTAINS
MFR: ARCHITEX
FABRIC: RX 1088
COLOR: (TBD)
SIZE: 72" WIDE

10 26 00 WALL PROTECTION

WP-1 ITEM: CUSTOM GRAPHIC WALL PROTECTION
MFR: MOHAWK GROUP
PRODUCT: TARGA RIGID WALL PROTECTION
SUBSTRATE: CUSTOM, 5 DESIGNS
GRAPHIC: DESIGN #1 - UNIQUE GRAPHIC IMAGE
DESIGN #2 - SOLID COLOR (CUSTOM)
DESIGN #3 - UNIQUE GRAPHIC IMAGE
DESIGN #4 - UNIQUE GRAPHIC IMAGE
DESIGN #5 - SOLID COLOR (CUSTOM)
MANUFACTURERS STANDARD TRIM AT ALL EXPOSED EDGES. CLEAR CAULK AT ALL SEAMS (AT GRAPHICS), COLOR-MATCHED CAULK (AT CUSTOM SOLID COLORS).
FULL HEIGHT AND WIDTH OF WALLS WHERE INDICATED. REFER TO ELEVATIONS AND DETAILS

WP-2 ITEM: WALL PROTECTION PANELS
MFR: CONSTRUCTION SPECIALTIES
PRODUCT: CS ACROVYN 4000 SHEET
THICKNESS: 0.040"
COLOR: DRIFTWOOD #262
TEXTURE: SUEDE
INSTALL: PANELS TO BE RUN VERTICALLY AND INSTALLED FULL HEIGHT, TO UNDERSIDE OF CEILING. MFR'S COORDINATING TRIM TO BE USED AT ALL EDGES, INCLUDING WHERE PANELS MEET DOOR FRAMES. ALL VERTICAL SEAMS TO RECEIVE CUSTOM COLOR-MATCHED CAULK.

WP-3 ITEM: WALL PADDING
MFR: GOLD MEDAL SAFETY PADDING
PRODUCT: SAFETY PADDING FOR WALLS
THICKNESS: 1 1/2" THICK
COLOR: TAN (STANDARD COLOR)
INSTALL: REFER TO MFR'S DETAILS AND SPECIFICATIONS. APPLY FROM 0'-0" AFF TO 8'-0" AFF.

CG-1 ITEM: CORNERGUARDS
MFR: CONSTRUCTION SPECIALTIES
PRODUCT: CS CO-8
SERIES: CO-8
LEG: 2" LENGTH
GAUGE: 14
FINISH: #4 SATIN
ANGLE: AS NEEDED (MODEL CO-8 FOR 90 DEGREE CORNERS, MODEL CO-8M FOR ODD-DEGREE ANGLES)
INSTALL: USE MECHANICAL FASTENERS. HOLD OFF FLOOR - 4" (FROM TOP OF BASE). RUN FULL HEIGHT OF WALL TO UNDERSIDE OF CEILING.

RS-1 ITEM: MANUAL ROLLER WINDOW SHADES
MFR: MECO SHADE
BRACKET: MECO'S
FASCIA: SNAP-LOCK
FABRIC: ECOVEIL 1550 SERIES, 3% OPEN
COLOR: (TBD)
INSTALL: WITH CHAIN SECURED TO WALL, TO BE INSTALLED AT ALL EXTERIOR WINDOWS

SS-1 ITEM: SOLID SURFACE
MFR: CORIAN DUPONT
COLOR: GRANITE
INSTALL: ALL WALL CAPS WHERE APPLICABLE

GR-1 ITEM: GRANITE
SLAB: VALLE NEVADO OR NEW CALEDONIA
FINISH: POLISHED
EDGE: EASED
THICKNESS: 3 CM (-1.18")
INSTALL: ALL NEW COUNTERS WHERE APPLICABLE

12 24 13 ROLLER WINDOW SHADES

RS-1 ITEM: MANUAL ROLLER WINDOW SHADES
MFR: MECO SHADE
BRACKET: MECO'S
FASCIA: SNAP-LOCK
FABRIC: ECOVEIL 1550 SERIES, 3% OPEN
COLOR: (TBD)
INSTALL: WITH CHAIN SECURED TO WALL, TO BE INSTALLED AT ALL EXTERIOR WINDOWS

12 36 00 COUNTERTOPS

SS-1 ITEM: SOLID SURFACE
MFR: CORIAN DUPONT
COLOR: GRANITE
INSTALL: ALL WALL CAPS WHERE APPLICABLE

GR-1 ITEM: GRANITE
SLAB: VALLE NEVADO OR NEW CALEDONIA
FINISH: POLISHED
EDGE: EASED
THICKNESS: 3 CM (-1.18")
INSTALL: ALL NEW COUNTERS WHERE APPLICABLE

12 48 13 ENTRANCE FLOOR MATS

WM-2 ITEM: MODULAR CARPET WALK-OFF MAT
MFR: MOHAWK GROUP
COLLECTION: TUFF STUFF II
ITEM # CT315
PRODUCT: IRON GRE
SIZE: 24" x 24"
INSTALL: BRICK ASHLAR

ALTERNATES

06 49 23 INTERIOR ARCHITECTURAL WOODWORK

MB-1 ITEM: MILLWORK BASE - PAINT GRADE WOOD
MFR: ARCHITEX
FABRIC: RX 1088
SPECIES: MAPLE
SIZE: SQUARE WITH EASED EDGE
COLOR: FLAT STOCK 1x3
NOTE: PAINT PT-2 (ALTERNATE FOR INTEGRAL BASE IF GE-1 IS OPTED FOR IN LIEU OF WP-3) REFER TO DETAIL

10 11 00 VISUAL DISPLAY SURFACES

VD-2 ITEM: MAGNETIC WHITEBOARD
MFR: MAGNATAG
PRODUCT: INDIVIDUAL WHITEBOARD WALL PANELS
PANEL SIZE: 60" x 48"
ORIENT.: VERTICAL
STYLE: PLAIN WHITE
NOTE: (ALTERNATE FOR PT-5)

10 26 00 WALL PROTECTION

WP-2A ITEM: WALL PROTECTION PANELS
MFR: CONSTRUCTION SPECIALTIES
PRODUCT: CS ACROVYN 4000 SHEET
THICKNESS: 0.040"
COLOR: (TBD)
TEXTURE: SUEDE
INSTALL: PANELS TO BE RUN VERTICALLY AND INSTALLED FULL HEIGHT, TO UNDERSIDE OF CEILING. MFR'S COORDINATING TRIM TO BE USED AT ALL EDGES, INCLUDING WHERE PANELS MEET DOOR FRAMES. ALL VERTICAL SEAMS TO RECEIVE CUSTOM COLOR-MATCHED CAULK. (ALTERNATE FOR WP-2)

11 66 23 GYMNASIUM EQUIPMENT

GE-1 ITEM: ATHLETIC WALL PADS
MFR: PORTER ATHLETIC COMPANY
PRODUCT: SUPER SAFE WALL PADS
SIZE: 67H x 24W x 2D (VARIES, V.I.F.)
COLOR: TBD (MINIMUM OF 2)
INSTALL: WALL-MOUNTED
NOTE: TO BE INSTALLED 4" AFF TO ACCOMMODATE WALL BASE. USE APPROPRIATE MOLDING AND/OR ACCESSORIES WHERE APPLICABLE. ALL DEVICES TO BE RECESSED IN PADS. REFER TO ELECTRICAL DRAWINGS. (ALTERNATE FOR WP-3)

Tecton
ARCHITECTS

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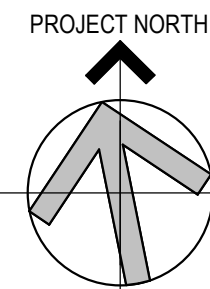
WEST WARWICK
PUBLIC SCHOOLS

10 Harris Ave
West Warwick, RI 02893

Project

30 PAYAN ST

30 PAYAN STREET
WEST WARWICK, RI 02893



Seals

Issues / Revisions

No.	Date	Description
1	11/05/2025	DESIGN DEVELOPMENT
2	01/26/2026	100% CONSTRUCTION DOCUMENTS
3	02/11/2026	ADDENDUM 2

Drawing Title

FINISH PLANS &
MATERIALS LIST

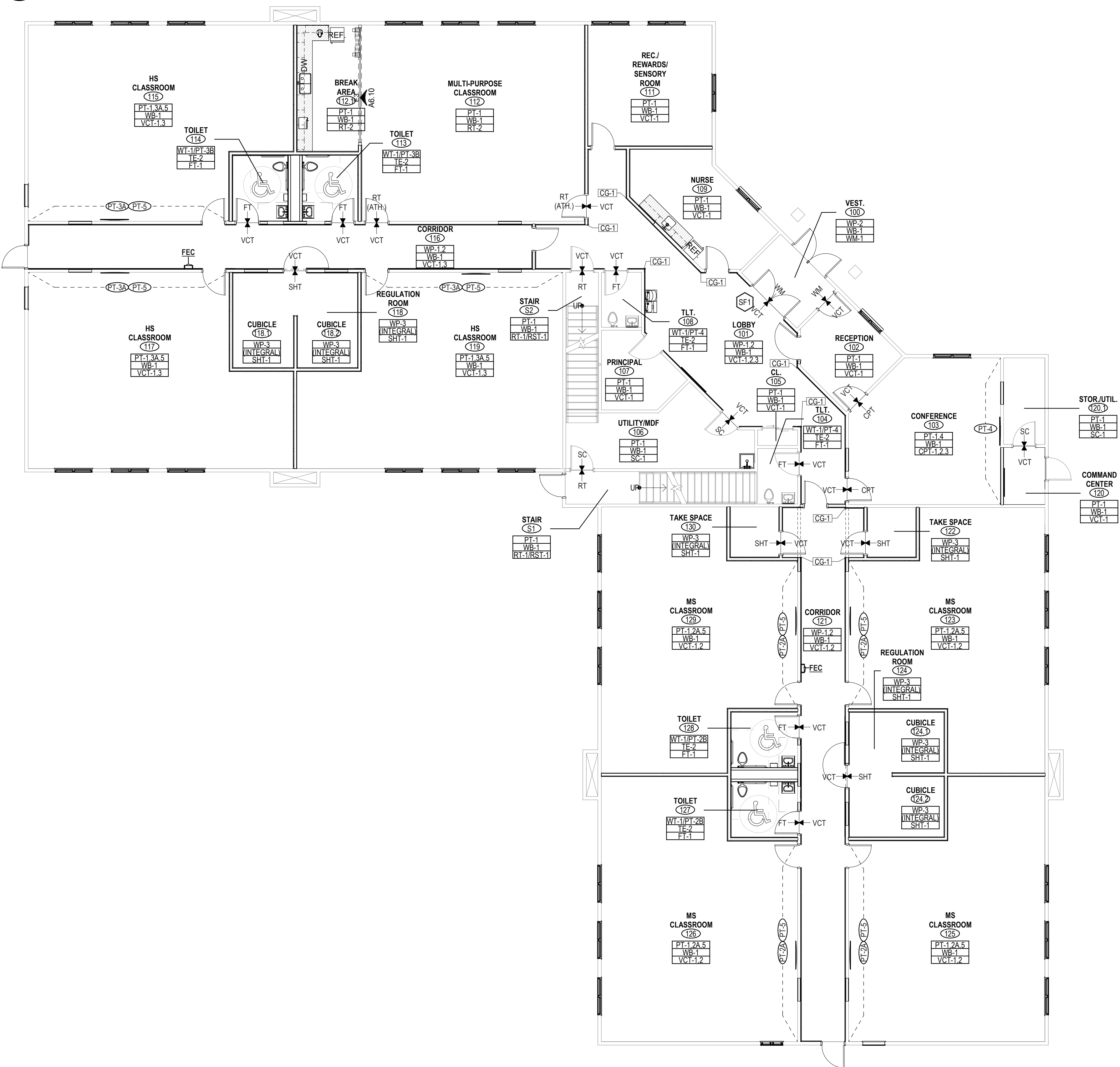
Project Manager:	JH	Project No.:	WW0202AR
Project Architect:	AC	Production Leader:	NA
Project Designer:	KM	Peer Reviewer:	EW

Drawing Number

12.10

D12 SECOND FLOOR FINISH PLAN

1/8" = 1'-0"



K12 FIRST FLOOR FINISH PLAN

1/8" = 1'-0"

DEMOLITION AND REMOVALS

1. WHEN NECESSARY TO TEMPORARILY DISCONNECT ANY EXISTING FEEDER OR BRANCH CIRCUIT SUPPLYING OCCUPIED FACILITIES, CONFER WITH THE OWNER, AND SCHEDULE A MUTUALLY AGREEABLE PERIOD OF INTERRUPTION.
2. WHERE REPLACEMENT, RELOCATION OR MODIFICATION OF EXISTING EQUIPMENT IS INDICATED, PROVIDE AND MAINTAIN ALL TEMPORARY FEEDERS, CONNECTIONS, CIRCUIT PROTECTION, AND ANY OTHER MATERIALS AND APPURTENANCES REQUIRED TO MAINTAIN SERVICES TO OCCUPIED AREAS.
3. NO WORK SHALL BE LEFT INCOMPLETE, NOR ANY HAZARDOUS SITUATION CREATED, WHICH WILL AFFECT THE LIFE OR SAFETY OF THE PUBLIC AND/OR BUILDING OCCUPANTS. AT NO TIME SHALL THE WORK INTERFERE WITH OR CUT OFF ANY OF THE EXISTING SERVICES WITHOUT THE OWNER'S PRIOR WRITTEN PERMISSION.
4. THE OWNER RESERVES THE RIGHT TO OPERATE ALL EXISTING ELECTRICAL AND MECHANICAL EQUIPMENT NOT INCLUDED IN THIS WORK, AND TO PERFORM ALL REQUIRED SERVICING AND REPAIRS TO SAME, AT ALL TIMES.
5. IT IS REQUIRED THAT THE WORK INDICATED AND/OR SPECIFIED SHALL BE CARRIED OUT WITH MINIMUM INTERFERENCE TO THE ESTABLISHED OPERATIONS OF THE BUILDINGS.
6. REMOVE, ABANDON, REROUTE, OR RELOCATE ANY CONDUIT, WIRING, LIGHTING FIXTURES, OUTLETS, AND OTHER ELECTRICAL ITEMS, WHICH ARE LAD BARE IN THE COURSE OF, OR INTERFERE WITH, THE ALTERATIONS. REMOVE ALL EXPOSED OUTLETS, CONDUIT, AND BRANCH CIRCUIT WORK, WHICH INTERFERE WITH THE ALTERATIONS.
7. IT IS THE INTENTION OF THESE SPECIFICATIONS TO PROVIDE FOR THE CONTINUANCE OF ALL ELECTRICAL SERVICES PRESENTLY INSTALLED IN THE UNALTERED AREAS. PROVIDE ALL CONDUIT, WIRING, AND DEVICES NECESSARY TO MAINTAIN SERVICES TO THESE AREAS.
8. COMPARE THE PLANS WITH THE EXISTING CONDITIONS TO DETERMINE THE AMOUNT OF WORK AFFECTED. REMOVE ALL UNUSED EXPOSED CIRCUIT WORK, OUTLETS, FIXTURES AND THE LIKE NOT REQUIRED BY THE ALTERATIONS.
9. ALL MATERIALS REQUIRED TO BE REMOVED AND NOT REINSTALLED UNDER THIS DIVISION OF THE WORK, UNLESS OTHERWISE INDICATED, SHALL BECOME THE PROPERTY OF THE CONTRACTOR, AND SHALL BE REMOVED FROM THE SITE.
10. WHERE FEEDERS AND BRANCH CIRCUITS OR DEVICES AND EQUIPMENT ARE INDICATED TO BE REMOVED, CONDUCTORS AND CABLES SHALL BE COMPLETELY REMOVED BACK TO THEIR SOURCE, OR IF APPLICABLE, BACK TO UPSTREAM ETR DEVICE. EXPOSED OR ACCESSIBLE CONDUITS SHALL BE REMOVED COMPLETELY. CONDUITS EMBEDDED IN CONCRETE OR MASONRY SHALL BE CUT OFF FLUSH AND THE SURFACE PATCHED SMOOTH AND LEVEL.
11. WHERE DEVICES AND/OR EQUIPMENT ARE INDICATED TO BE RELOCATED, CONDUCTORS AND RACEWAY SHALL BE EXTENDED TO THE NEW LOCATION AND RECONNECTED TO PROVIDE A COMPLETE WORKING SYSTEM. IF THERE ARE ASSOCIATED DEVICES WITH THE RELOCATED EQUIPMENT THEY SHALL BE RELOCATED AS WELL, UNLESS OTHERWISE NOTED, AND CONNECTED INTO THE SYSTEM.
12. REMOVED MATERIALS SHALL BE DISPOSED OF USING LICENSED CARTING SERVICE.
13. HAZARDOUS MATERIALS - CONTAINING PCB'S (BALLASTS), AND THE LIKE SHALL BE DISPOSED OF BY AN EPA APPROVED, LICENSED DISPOSAL SERVICE. CONTRACTOR SHALL OBTAIN AND HAVE ON FILE, AFFIDAVIT, AND RECEIPTS STATING HOW AND WHERE THE WASTE WAS DISPOSED OF OR CONVERTED.
14. CONTRACTOR SHALL REMOVE ALL ELECTRICAL EQUIPMENT IN OR ON WALLS THAT ARE TO BE REMOVED - MAINTAIN CONTINUITY OF ALL EXISTING BRANCH CIRCUITRY TO EXISTING ROOMS NOT BEING RENOVATED. REWIRE ALL EXISTING BRANCH CIRCUITS (THAT ARE TO REMAIN) AS REQUIRED. REFER TO ARCHITECTURAL DEMOLITION DRAWINGS FOR WALLS BEING REMOVED.
15. CONDUIT IN EXISTING OR NEW CEILINGS THAT IS NOT INTENDED FOR REUSE SHALL BE REMOVED BACK TO THE PANEL FROM WHICH IT ORIGINATES.
16. CONDUCTORS THAT ARE NOT DEEMED REUSABLE SHALL BE REMOVED BACK TO THE NEAREST JUNCTION BOX WHERE THE ENTIRE CIRCUIT IS TO BE REMOVED. THE CONDUCTORS SHALL BE REMOVED BACK TO THE PANEL FROM WHICH THEY ORIGINATE.
17. OUTAGES OF EXISTING ELECTRICAL (LIGHTING, POWER, AND SIGNAL) SYSTEMS NECESSITATED BY WORK OF ALL TRADES SHALL BE IN ACCORDANCE WITH FIELD SCHEDULES BY THE GENERAL CONTRACTOR AND OWNER. INCLUDE ALL ELECTRIC WORK OVERTIME AND SUPERVISION TO COMPLY - CONTRACTOR SHALL OBTAIN OWNER'S GENERAL CONTRACTOR'S APPROVAL PRIOR TO DISRUPTING EXISTING ELECTRICAL SYSTEM.
18. CONTRACTOR TO MAINTAIN CONTINUITY AND ACCESSIBILITY OF ALL EXISTING SYSTEMS AND SYSTEM EQUIPMENT FEEDERS WHICH MAY BE DISRUPTED FOR WORK OF ANY TRADE.
19. ANY EXISTING ELECTRICAL WORK WHICH IS PULLED OUT OR CUT AWAY SHALL BE REMOVED FROM THE SITE AS DIRECTED BY THE GENERAL CONTRACTOR AND THE OWNER.
20. EXISTING ELECTRICAL EQUIPMENT WHICH IS NOT TO BE REUSED SHALL BE REMOVED FROM DRYWALL PARTITIONS. ANY OPENING IN EXISTING PARTITIONS LEFT BY REMOVAL OF EXISTING ELECTRICAL EQUIPMENT SHALL BE PATCHED BY THIS CONTRACTOR WITH MATERIALS TO MATCH EXISTING.
21. FOR PURPOSES OF THE CONTRACT, WHAT IS NOTED OR SHOWN ON DRAWINGS INDICATES THE SCOPE OF WORK REQUIRED AND QUALITY OF MATERIALS REQUIRED.
22. CONTRACTOR TO EXAMINE ALL CONTRACT DOCUMENTS AND PERFORM ALL DEMOLITION BOTH FOR AREAS BEING RENOVATED AND FOR AREAS WHICH MUST BE REWORKED TO PERMIT THE INSTALLATION OF WORK BY THE VARIOUS TRADES.
23. CONTRACTOR SHALL VISIT THE SITE AND VERIFY THE EXTENT OF DEMOLITION AND REMOVALS PRIOR TO THE SUBMISSION OF BIDS. NO CONSIDERATION SHALL BE GIVEN FOR FAILURE TO VISIT THE SITE.
24. CONTRACTOR SHALL UTILIZE ALL THE CIRCUIT BREAKERS IN THE EXISTING PANELS THAT BECOME AVAILABLE WHEN BRANCH CIRCUITS ASSOCIATED WITH THEM ARE DISCONNECTED AND REMOVED DUE TO DEMOLITION OF THE ELECTRICAL WORK.

GENERAL NOTES

GENERAL:

1. WHEN A CONFLICT BETWEEN THE DRAWINGS, NOTES AND/OR SPECIFICATIONS OCCUR, THE MORE STRINGENT, AND/OR LARGER QUANTITY AND/OR MORE EXPENSIVE SHALL APPLY. THE REQUIREMENTS LISTED WITHIN NOTES OR SPECIFICATIONS SHALL BE REQUIRED, PROVIDED AND INSTALLED WHETHER SPECIFICALLY INDICATED ON THE DRAWINGS OR NOT.
2. THE DRAWINGS AND SPECIFICATIONS ARE DIVIDED INTO SECTIONS TO MEET THE NEEDS OF THE ARCHITECT, THE ENGINEERS, AND THE DESIGN CONSULTANTS. THEY ARE NOT PREPARED AS INSTRUCTIONS TO THE CONTRACTOR FOR HOW TO BUY OUT OR SUBCONTRACT THE WORK. THE CONTRACTOR IS RESPONSIBLE FOR ALL THE WORK DESCRIBED IN THE CONTRACT DOCUMENTS, REGARDLESS OF WHERE IT IS SHOWN. FOR EXAMPLE, ELECTRICAL WORK IS SHOWN ON FP-SERIES DRAWINGS AS WELL AS ON M-SERIES DRAWINGS AND E-SERIES DRAWINGS. STRUCTURAL SUPPORTS ARE REQUIRED BY THE FP-SERIES DRAWINGS. TO AVOID OMITTING ANY COMPONENT OF THE PROJECT, REFER TO ALL THE CONTRACT DOCUMENTS IN THEIR ENTIRETY.

WIRING & RACEWAY:

1. THE DRAWINGS SHOW THE GENERAL LAYOUT AND TYPICAL DETAILS. PROVIDE COMPLETE SYSTEMS. DRAWINGS ARE BASED ON THE SPECIFIED EQUIPMENT, RACEWAY LAYOUTS, BOXES, AND WIRING OF THE SYSTEMS ARE SUBJECT TO APPROVED SHOP DRAWINGS.
2. ENSURE THAT ITEMS TO BE FURNISHED FIT THE SPACE AVAILABLE. MAKE NECESSARY FIELD MEASUREMENTS TO ASCERTAIN SPACE REQUIREMENTS, INCLUDING THOSE FOR CONNECTIONS, AND PROVIDE SUCH SIZES AND SHAPES OF EQUIPMENT THAT FINAL INSTALLATION SHALL SATISFY THE INTENT OF THE DRAWINGS AND SPECIFICATIONS.
3. LOCATIONS OF OUTLETS, SWITCHES, APPLIANCES, ETC. AS SHOWN ON ELECTRICAL PLANS ARE APPROXIMATE. COORDINATE WITH ARCHITECTURAL AND MECHANICAL PLANS AND DETAILS, AND WITH JOB CONDITIONS. INSTALL SWITCHES WITH "OFF" POSITION DOWN. INSTALL RECEPTACLES WITH GROUNDING POLE IN THE UP POSITION FOR VERTICAL MOUNTING AND AT LEFT FOR HORIZONTAL MOUNTING.
4. LOCATE AND INSTALL ELECTRICAL EQUIPMENT, JUNCTION AND PULL BOXES, PANELBOARDS, SWITCHES, CONTROLS, AND OTHER APPARATUS REQUIRING MAINTENANCE, INSPECTION, AND OPERATION SO AS TO BE READILY ACCESSIBLE.

RACEWAY INSTALLATION:

1. IN ALL ARCHITECTURALLY FINISHED SPACES, CONDUITS AND CABLES SHALL BE RUN CONCEALED IN HUNG OR FURRED CEILINGS, SLABS, MASONRY, AND PARTITIONS UNLESS OTHERWISE INDICATED. CONCEAL CONDUITS AND CABLES IN CONDUITS EMBEDDED IN CONCRETE OR MASONRY WALLS. IN UNFINISHED SPACES, RACEWAYS MAY BE RUN EXPOSED.
2. UNLESS OTHERWISE INDICATED, EXACT ROUTING OF RACEWAYS SHALL BE DETERMINED BY THE CONTRACTOR TO SUIT PROJECT REQUIREMENTS AND FIELD CONDITIONS.
3. PROVIDE SEPARATE RACEWAYS, JUNCTION BOXES, PULL BOXES AND WIREWAYS FOR ALL EMERGENCY SYSTEM WIRING.

WIRING INSTALLATION:

1. DO NOT USE WIRE SMALLER THAN NO. 12 AWG FOR ANY POWER OR LIGHTING CIRCUIT. USE LARGER SIZES WHERE INDICATED, AS REQUIRED BY CODES, AND AS FOLLOWS:
- | | |
|--------------------|--------|
| 30 AMPERE CIRCUIT: | NO. 10 |
| 40 AMPERE CIRCUIT: | NO. 8 |
| 50 AMPERE CIRCUIT: | NO. 6 |
| 60 AMPERE CIRCUIT: | NO. 4 |
- A. MINIMUM HOMERUN AND BRANCH CIRCUIT WIRING SIZES AND MAXIMUM HOMERUN CONDUIT FILL FOR 120 VOLT, 20 AMPERE CIRCUITS SHALL BE AS FOLLOWS:

LENGTH	CIRCUIT WIRE SIZE	HOMERUN WIRE SIZE	CONDUIT SIZE (8 WIRES/CONDUIT)
0' TO 50'	#12	#12	3/4"
51' TO 100'	#12	#10	3/4"
101' TO 200'	#10	#8	1"

GREATER THAN 200' - REQUEST DIRECTION FROM ENGINEER.

- NOTE: PROVIDE DERATING PER CODE WHEN INSTALLING MORE THAN 3 CURRENT CARRYING CONDUCTORS IN CONDUIT.
2. DO NOT USE WIRE SMALLER THAN NO. 14 AWG FOR CONTROL CIRCUITS UNLESS OTHERWISE RECOMMENDED BY THE EQUIPMENT OR SYSTEM MANUFACTURER ON WIRING SHOP DRAWINGS, AND SO APPROVED BY THE ENGINEER.
3. WHERE GREATER THAN THREE (3) CURRENT-CARRYING CONDUCTORS ARE INSTALLED IN ANY ONE CONDUIT OR CABLE TRAY SHOP DRAWINGS, THE CONTRACTOR IS REQUIRED, IF NEEDED, TO ACCOMMODATE CONDUCTOR DERATING AS REQUIRED BY NEC ARTICLE 310.
4. CONDUCTORS SHALL BE COMPLETELY INSTALLED AND CONNECTED. PROVIDE ALL TERMINALS, LUGS, AND CONNECTORS TO SUIT THE APPLICATION, AND IN COMPLIANCE WITH EQUIPMENT MANUFACTURERS' RECOMMENDATIONS.
5. UNDER NO CIRCUMSTANCES SHALL ANY SWITCH OR CIRCUIT BREAKER BREAK A NEUTRAL CONDUCTOR.
6. THE CIRCUIT NUMBERS INDICATED ON THE DRAWINGS ARE INTENDED AS A GUIDE FOR PROPER CONNECTION OF CIRCUITS AT PANELBOARDS. HOWEVER, IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE THAT THE FINAL CIRCUITING WORK FULFILLS THE FOLLOWING CONDITIONS:
- A. LOADS ON PANELBOARD BUSES SHALL BE PHASE-BALANCED AS EVENLY AS POSSIBLE.
7. PROVIDE SEPARATE NEUTRALS FOR EACH CIRCUIT. WHERE MULTIPLE CIRCUITS ARE INSTALLED IN THE SAME RACEWAY OR ENCLOSURE, IDENTIFY NEUTRALS WITH CORRESPONDING BRANCH CIRCUIT PHASE CONDUCTOR NUMBERS.

UNIT PRICING:

1. CONTRACTOR SHALL PROVIDE A COMPLETED TABLE OF UNIT COSTS AT TIME OF BID ASSOCIATED WITH THE INSTALLATION OF FOLLOWING WORK. THIS PRICING WILL BE HELD FOR THE DURATION OF THE PROJECT. MATERIALS UTILIZED SHALL BE IN ADDITION TO ANY EQUIPMENT SPECIFIED AS "SPARE PARTS" IN DRAWINGS AND SPECIFICATIONS. SUCH WORK SHALL INCLUDE BOTH FURNISH AND INSTALL OF ALL ASSOCIATED EQUIPMENT, CONDUIT AND WIRING TO MAKE COMPLETE SYSTEM, AND TO BE COMPLETED PRIOR TO SYSTEM APPROVAL AND AS-BUILT DOCUMENTATION. PATCH AND PAINT WORK SHALL NOT BE INCLUDED IN THE ELECTRICAL CONTRACTOR'S UNIT PRICE VALUES. FIRE STOPPING PENETRATIONS SHALL BE INCLUDED.

- A. 20A/1P CIRCUIT BREAKER AND 100' OF 2#12 - #12G - 3/4".
- B. 30A/1P CIRCUIT BREAKER AND 100' OF 2#10 - #10G - 3/4".
- C. 20A/2P CIRCUIT BREAKER AND 100' OF 2#12 - #12G - 3/4".
- D. 30A/2P CIRCUIT BREAKER AND 100' OF 2#10 - #10G - 3/4".
- E. 20A/2P CIRCUIT BREAKER AND 100' OF 3#12 - #12G - 3/4".
- F. 30A/3P CIRCUIT BREAKER AND 100' OF 3#10 - #10G - 3/4".
- G. EXIT SIGN AND 100' OF 2#12 - #12G - 3/4".

GROUNDING INSTALLATION:

1. EQUIPMENT GROUNDING

- A. INSTALL AN INSULATED GROUND CONDUCTOR, RUN IN THE RACEWAY WITH THE PHASE CONDUCTORS, FOR EACH FEEDER SERVING PANELBOARDS, LIGHTING DIMMER BORDS, MOTOR CONTROL CENTERS, MOTORS, EQUIPMENT AND APPLIANCES UNLESS OTHERWISE NOTED.
- B. INCLUDE AN INSULATED GROUND CONDUCTOR IN ALL CONDUIT RUNS CONTAINING SECTIONS OF FLEXIBLE CONDUIT UNLESS OTHERWISE NOTED.
- C. INCLUDE AN INSULATED GROUND CONDUCTOR IN ALL BRANCH CIRCUIT RACEWAYS OR CABLES UNLESS OTHERWISE NOTED.

DEVICES:

1. ALL NEMA 5-15R AND 5-20R RECEPTACLES SHALL BE TAMPER RESISTANT TYPE.

SHORT CIRCUIT, COORDINATION, AND ARC FLASH STUDIES

1. CONTRACTOR SHALL PROVIDE A SHORT CIRCUIT, ARC FLASH, AND COORDINATION STUDY (REFER TO SPECIFICATIONS). TO ACCURATELY PERFORM THE STUDIES, STUDIES SHALL INCLUDE, BUT ARE NOT LIMITED TO, THE EXISTING UTILITY TRANSFORMER, EXISTING PANELBOARDS, EXISTING CONDUIT AND WIRE, AND EXISTING MOTOR LOADS WHERE INDICATED ON SINGLE LINE / RISER DIAGRAM. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONTACTING EQUIPMENT MANUFACTURERS, THE UTILITY COMPANY, AND OWNER FOR INFORMATION ON EXISTING EQUIPMENT REQUIRED BY THE STUDIES.

OTHER TRADES EQUIPMENT WIRING:

1. UNLESS OTHERWISE INDICATED OR SPECIFIED HEREIN, ALL MOTORS, MOTOR STARTERS, MOTOR CONTROLLERS, VARIABLE SPEED/FREQUENCY DRIVES, AND ASSOCIATED CONTROL DEVICES ARE FURNISHED UNDER OTHER DIVISIONS AND INSTALLED UNDER THIS DIVISION. COORDINATE INSTALLATION AND LOCATIONS WITH OTHER DIVISION CONTRACTORS.
2. POWER WIRING FROM THE INDICATED SOURCE TO THE STARTER/CONTROLLER/DRIVE UNIT, AND FROM THE STARTER/CONTROLLER/DRIVE UNIT TO THE MOTOR, INCLUDING ANY LOCAL DISCONNECT SWITCHES PROVIDED AND/OR INSTALLED BY THIS DIVISION, AND ALL ASSOCIATED LUGS, TERMINALS, AND CONNECTIONS, IS THE WORK OF THIS DIVISION.
3. CONTROL CIRCUIT WIRING IS GENERALLY FURNISHED AND INSTALLED UNDER OTHER DIVISIONS, EXCEPT THAT ANY SUCH WIRING SHOWN ON ELECTRICAL DRAWINGS IS WORK OF THIS DIVISION.
4. PROVIDE 120 VOLT POWER TO ALL TEMPERATURE CONTROL PANELS (TCP'S) SUPPLIED AND INSTALLED BY DIVISION 23 COORDINATE ALL POWER REQUIREMENTS AND PANEL LOCATIONS WITH DIVISION 23 TEMPERATURE CONTROLS CONTRACTOR.
5. COOPERATE AND COORDINATE WITH THE OTHER TRADES IN THE INSTALLATION, CONNECTION, AND TESTING OF MECHANICAL EQUIPMENT. PERFORM WORK OF THIS SECTION IN ACCORDANCE WITH EQUIPMENT MANUFACTURERS' INSTRUCTIONS.
6. EACH ELECTRICAL BRANCH CIRCUIT IDENTIFIED ON DRAWINGS FOR TERMINAL BOXES SHALL BE USED TO ENERGIZE UP TO 20 TERMINAL BOXES. PROVIDE CONDUIT AND WIRE FROM JUNCTION BOX SHOWN ON DRAWINGS TO EACH TERMINAL BOX AND PROVIDE AN EXTERNAL DISCONNECT SWITCH CONNECTED AHEAD OF EACH TERMINAL BOX. SUPPLEMENT WITH ADDITIONAL BRANCH CIRCUITS AS REQUIRED. REFER TO M-SERIES DRAWINGS FOR ALL TERMINAL BOX LOCATIONS AND DETAILS.
7. EACH ELECTRICAL BRANCH CIRCUIT IDENTIFIED FOR SMOKE OR FIRE SMOKE DAMPERS ON DRAWINGS SHALL BE USED TO ENERGIZE UP TO 20 SMOKE AND FIRE SMOKE DAMPERS. PROVIDE CONDUIT AND WIRE FROM JUNCTION BOX SHOWN ON DRAWINGS TO EACH DAMPER. REFER TO M-SERIES DRAWINGS FOR ALL SMOKE AND FIRE SMOKE DAMPER LOCATIONS.
8. REFER TO M-SERIES DRAWINGS FOR ALL DUCT SMOKE DETECTOR LOCATIONS. FURNISH AND INSTALL ALL DUCT SMOKE DETECTORS SHOWN, U.O.N. ALL DUCT SMOKE DETECTORS SHALL BE CONNECTED TO THE FIRE ALARM SYSTEM. PROVIDE CONDUIT AND WIRE TO EACH DETECTOR AS IDENTIFIED ON FIRE ALARM RISER DIAGRAM.
9. REFER TO FP-SERIES DRAWINGS FOR ALL TAMPER, FLOW, AND PRESSURE SWITCH DEVICE LOCATIONS. PROVIDE MONITORING MODULES, CONDUIT, WIRING AND PROGRAMMING FOR ALL DEVICES SHOWN EVEN IF NOT SHOWN ON THE E-SERIES DRAWINGS.

COORDINATION DRAWINGS:

1. DEVELOP AND SUBMIT COORDINATION DRAWINGS AS OUTLINED.
- A. SHEET METAL, PLUMBING AND FIRE PROTECTION SHOP DRAWINGS THAT HAVE BEEN COORDINATED WITH ARCHITECTURAL AND STRUCTURAL DRAWINGS SHALL BE SUBMITTED TO ARCHITECTURE FOR REVIEW. DRAWINGS MUST BE RETURNED FROM ENGINEER EITHER "REVIEWED" OR "TURNISH AS CORRECTED" PRIOR TO BEING USED AS BASIS FOR COORDINATION DRAWINGS.
- B. AFTER SHEET METAL AND PIPING DRAWINGS HAVE BEEN REVISED PER ENGINEERS COMMENTS, REPRODUCIBLE COPIES SHALL BE SENT TO THE TRADES IN THE FOLLOWING SEQUENCE FOR THE INCLUSION OF THEIR WORK:
- MECHANICAL SHEET METAL
 - PLUMBING PIPING
 - MECHANICAL PIPING
 - SPRINKLER PIPING
 - ELECTRICAL WORK
2. AFTER ALL TRADES HAVE INCLUDED THEIR WORK ON THE COORDINATION DRAWING AND NOTED CONFLICTS, ALL TRADES SHALL MEET TO RESOLVE CONFLICTS AND AGREE TO ACCEPTABLE SOLUTIONS. EACH TRADE SHALL SIGN COORDINATION DRAWINGS. ITEMS NOT SHOWN ON COORDINATION DRAWING IS RESPONSIBILITY OF OMITTING CONTRACTOR AND CONTRACTOR IS SUBJECT TO ADDITIONAL COSTS INCURRED BY OTHER TRADES.
3. THE ARCHITECT AND ENGINEER ARE NOT PART OF THE COORDINATION DRAWING PROCESS. THE ENGINEER WILL PROVIDE ASSISTANCE FOR NOTED CONFLICTS ONLY. COORDINATION DRAWINGS ARE NOT TO BE CONSIDERED PIPING OR DUCT SHOP DRAWINGS. THE CONTRACTOR IS REQUIRED TO SUBMIT INDIVIDUAL PIPING AND DUCTWORK SHOP DRAWINGS FOR REVIEW BY THE ENGINEER. PIPING AND DUCTWORK SHOP DRAWINGS SHALL FOLLOW THE DESIGN INTENT OF THE CONTRACT DOCUMENTS.
4. SUBMIT FINAL SIGNED COORDINATION DRAWING TO ENGINEER FOR REVIEW. ENGINEER WILL REVIEW COORDINATION DRAWINGS FOR GENERAL ARRANGEMENT AND FOR NOTED CONFLICTS ONLY. SPECIFIC INSTALLATION REQUIREMENTS SHALL BE REVIEWED ONLY IN INDIVIDUAL TRADE SHOP DRAWINGS.
5. ANY WORK FABRICATED OR INSTALLED PRIOR TO SIGN OFF BY ALL TRADES WHICH IS DEEMED TO BE IN CONFLICT WITH COORDINATION DRAWINGS SHALL BE REMOVED AND RE-INSTALLED IN CONFORMANCE WITH COORDINATION DRAWINGS.
6. EACH CONTRACTOR (MENTIONED ABOVE) IS RESPONSIBLE FOR THE COORDINATION OF HIS SUB-CONTRACTORS.
7. THE OVERALL COORDINATION OF THE COORDINATION PROCESS IS THE RESPONSIBILITY OF THE CONTRACTOR. THE ENGINEER IS NOT RESPONSIBLE FOR THE COORDINATION PROCESS. THE ENGINEER WILL RESPOND TO QUESTIONS THAT ARISE FROM THE COORDINATION PROCESS. DRAWINGS SUBMITTED WILL BE REVIEWED FOR CLEARLY IDENTIFIED CONFLICTS ONLY. SOLUTIONS TO CONFLICTS WILL NOT BEAR ADDITIONAL COST.

AS BUILT DRAWINGS:

1. PROVIDE A COMPLETE SET OF AS-BUILT DRAWINGS REFLECTING AS INSTALLED CONDITIONS. AS-BUILT DRAWINGS SHALL INDICATE ALL INSTALLED CONDITIONS OF SYSTEMS WITHIN THIS DISCIPLINE. DRAWINGS SHALL BE OF SIMILAR SCALE AS THE CONSTRUCTION DOCUMENTS AND INCLUDE DETAILS AS NECESSARY TO CLEARLY REFLECT THE INSTALLED CONDITION. DRAWINGS SHALL BE BOUND IN A COMPLETE AND CONSECUTIVE SET. SUPPLEMENTAL SKETCHES AND LOOSE PAPERWORK WILL NOT BE ACCEPTABLE AND WILL BE RETURNED FOR REVISION. THE CONTRACTOR SHALL COMPLY WITH THE ENGINEERS COMMENTS TO PRODUCE A CLEAR AND CONCISE SET OF DRAWINGS. DRAWINGS SHALL BE SUBMITTED IN BOTH HARD COPY AND ELECTRONIC (AUTO-CAD VERSION AS REQUIRED BY THE OWNER) VERSION. NUMBER OF COPIES OF EACH AS REQUESTED BY THE OWNER.
2. PROVIDE "AS-BUILT DRAWINGS" INDICATING IN A NEAT AND ACCURATE MANNER A COMPLETE RECORD OF ALL REVISIONS OF THE ORIGINAL DESIGN OF THE WORK. INDICATE THE FOLLOWING INSTALLED CONDITIONS:
- A. INCLUDE ALL CHANGES AND AN ACCURATE RECORD, ON REPRODUCTIONS OF THE CONTRACT DRAWINGS OR APPROPRIATE SHOP DRAWINGS, OF ALL DEVIATIONS, BETWEEN THE WORK SHOWN AND WORK INSTALLED.
- B. EQUIPMENT LOCATIONS (EXPOSED AND CONCEALED), DIMENSIONED FROM PROMINENT BUILDING LINES.
- C. APPROVED SUBSTITUTIONS, CONTRACT MODIFICATIONS, AND ACTUAL EQUIPMENT AND MATERIALS INSTALLED.
- D. CONTRACT MODIFICATIONS, ACTUAL EQUIPMENT AND MATERIALS INSTALLED.
- E. SUBMIT FOR REVIEW BOUND SETS OF THE REQUIRED DRAWINGS, MANUALS AND OPERATING INSTRUCTIONS.
- F. SUBMIT A COMPLETE MAINTENANCE MANUAL OF ALL EQUIPMENT INSTALLED UNDER THIS CONTRACT.
- G. SUBMIT AND PROVIDE TO OWNER AN 11" X 17" LAMINATED RISER DIAGRAM / SINGLE LINE DIAGRAM INDICATING ALL ELECTRICAL EQUIPMENT CAPACITIES AND VOLTAGES.

ELECTRICAL DRAWING LIST

DRAWING NUMBER	DRAWING DESCRIPTION
E0.01	COVER SHEET - ELECTRICAL
E0.02	LIGHTING FIXTURE SCHEDULE - ELECTRICAL
ED1.01	FIRST FLOOR DEMOLITION PLAN - ELECTRICAL
ED1.02	SECOND FLOOR DEMOLITION PLAN - ELECTRICAL
E1.01	FIRST FLOOR PLAN - ELECTRICAL
E1.02	SECOND FLOOR PLAN - ELECTRICAL
E2.01	FIRST FLOOR CEILING PLAN - LIGHTING
E2.02	SECOND FLOOR CEILING PLAN - LIGHTING
E4.01	SINGLE LINE DIAGRAM AND PANEL SCHEDULES - ELECTRICAL
E4.02	FIRE ALARM RISER DIAGRAM - ELECTRICAL
E6.01	DETAILS - ELECTRICAL
E6.02	DETAILS - ELECTRICAL

ELECTRICAL ABBREVIATIONS

A	AMPERES
AF	ABOVE FINISHED FLOOR
C	CONDUIT
C/B	CIRCUIT BREAKER
CKT	CIRCUIT
COF	COPIER
E	EXISTING
E.C.	ELECTRICAL CONTRACTOR
EM	EMERGENCY
ER	EXISTING RELOCATED
ETBR	EXISTING TO BE RELOCATED
ETR	EXISTING TO REMAIN
EW	ELECTRIC WATER COOLER
FACF	FIRE ALARM CONTROL PANEL WITH VOICE EVAC MICROPHONE
FBO	FURNISHED BY OTHERS
G	GROUND
HD	HAND DRYER
JB	JUNCTION BOX
MCB	MAIN CIRCUIT BREAKER
M.O.	MAIN LUG ONLY
MTD	MOUNTED
MW	MICROWAVE
PNL	PANEL
RAT	FIRE ALARM RADIO ALARM TRANSMITTER
REF	REFRIGERATOR
TCP	TEMPERATURE CONTROL PANEL
TSW	TWISTED SHIELD
U.O.N.	UNLESS OTHERWISE NOTED
V	VOLTS
VA	VOLT-AMPERES
VFD	VARIABLE FREQUENCY DRIVE (BY DIV. 23)
WP	WEATHER PROOF

ELECTRICAL SYMBOLS

A	#a	LIGHTING FIXTURE, UPPERCASE LETTER + TYPE, # = CIRCUIT, LOWERCASE LETTER + LIGHTING ZONE (TYP)
A	EM #a	EMERGENCY LIGHTING FIXTURE WITH BATTERY BACKUP
Sa		SINGLE POLE SWITCH, LETTER + LIGHTING ZONE (TYP)
SM		DISCONNECT SWITCH - TOGGLE TYPE, MOTOR RATED, 1HP, 20A, 1P., U.O.N.
SM2		DISCONNECT SWITCH - TOGGLE TYPE, MOTOR RATED, 1HP, 20A, 2P., U.O.N.
SLV		LOW VOLTAGE SWITCH
SLVD		LOW VOLTAGE DIMMER SWITCH
SCS		LOW VOLTAGE CONTROL STATION WITH PRESET SCENES
SOS		OCCUPANCY SENSOR SWITCH
SVS		VACANCY SENSOR SWITCH
SVSD		VACANCY SENSOR DIMMER SWITCH
CS		CEILING MOUNTED DUAL TECHNOLOGY 360° OCCUPANCY SENSOR
CS2		CEILING MOUNTED DUAL TECHNOLOGY 360° VACANCY SENSOR
DS		CEILING MOUNTED DAYLIGHT SENSOR
GR		DUPLEX CONVENIENCE RECEPTACLE - 18" AFF U.O.N.
GR		HALF SWITCHED DUPLEX RECEPTACLE (TYP, U.O.N.)
GRFI		DUPLEX GROUND FAULT INTERRUPTING RECEPTACLE - 18" AFF U.O.N.
GRRF		DUPLEX REFRIGERATOR RECEPTACLE - 48" AFF U.O.N.
GRTV		DUPLEX TELEVISION RECEPTACLE - 72" AFF U.O.N.
GR		DUPLEX CONVENIENCE RECEPTACLE - MOUNTED ABOVE COUNTER
GRFI		DUPLEX GROUND FAULT INTERRUPTING RECEPTACLE - MOUNTED ABOVE COUNTER
GR		QUAD CONVENIENCE RECEPTACLE - 18" AFF U.O.N.
GR		(2) HALF SWITCHED DUPLEX RECEPTACLES (TYP, U.O.N.)
GR		QUAD CONVENIENCE RECEPTACLE - MOUNTED ABOVE COUNTER
GR		SPECIAL CONFIGURATION RECEPTACLE, # = NEMA CONFIGURATION
GR		FLOOR BOX WITH (2) HALF SWITCHED DUPLEX RECEPTACLES, # = QUANTITY OF GANGS
JB		WALL MOUNTED JUNCTION BOX
JB		CEILING MOUNTED JUNCTION BOX
DIS		NON-FUSED DISCONNECT SWITCH, # = SWITCH SIZE
DIS		DISCONNECT SWITCH FURNISHED BY DIVISION 22/23, INSTALLED BY CONTRACTOR
F		FIRE ALARM MANUAL PULL STATION - 48" AFF U.O.N.
V		FIRE ALARM SPEAKER/STROBE - 80" AFF U.O.N.
L		FIRE ALARM STROBE LIGHT - 80" AFF U.O.N.
SD		SMOKE DETECTOR
HD		HEAT DETECTOR
C		CARBON MONOXIDE DETECTOR
TS		TAMPER SWITCH
FS		FLOW SWITCH
PS		PRESSURE SWITCH
FB		FIRE ALARM BELL
SD		FIRE SMOKE DAMPER (REFER TO M-SERIES DRAWINGS)
SD		SMOKE DAMPER (REFER TO M-SERIES DRAWINGS)
SD		DUCT MOUNTED SMOKE DETECTOR (REFER TO M-SERIES DRAWINGS)
M		MAGNETIC DOOR HOLDER
MM		FIRE ALARM MONITORING MODULE
CM		FIRE ALARM CONTROL MODULE
		END OF LINE RESISTOR
		PANELBOARD AND CLEARANCE
		CONDUCTOR/CONDUIT
		UNDERGROUND CONDUCTOR/CONDUIT
		BRANCH CIRCUIT HOMERUN (X = PANELBOARD, # = CIRCUIT NO.)

Tecton ARCHITECTS

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Project

30 PAYAN ST

30 PAYAN STREET
WEST WARWICK, RI 02893

Seals

Issues / Revisions		
No.	Date	Description
1	02/11/2026	ADDENDUM 2

Drawing Title

COVER SHEET - ELECTRICAL

Project Manager:		Project No: 25101	
Project Architect:		Production Leader:	
Project Designer:	CD	Peer Reviewer:	RM

Drawing Number

E0.01

Client/ Contracto

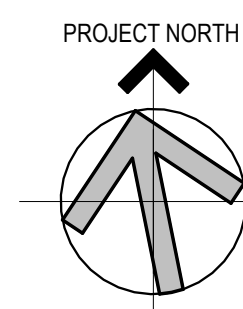
**WEST WARWICK
PUBLIC SCHOOLS**

10 Harris Ave
West Warwick, RI 02893

Project

30 PAYAN ST

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WEST WARWICK, RI 02893



Seals

[illegible]

Drawing Title

FIRST FLOOR
PLAN -
ELECTRICAL

Project Manager:	Project No:	25101
Project Architect:	Production Leader:	
Project Designer:	CD	Peer Reviewer: RM

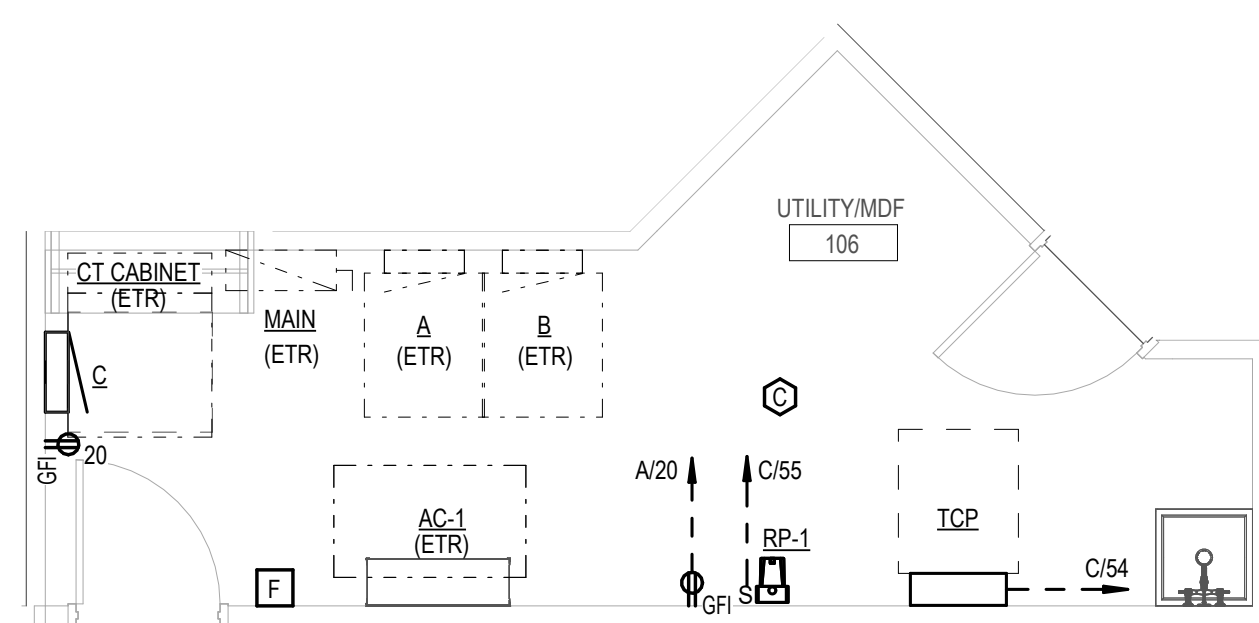
Drawing Number

E1.01

1. ROUTE BRANCH CIRCUIT FOR EXHAUST FAN VIA LOCAL LIGHTING CONTROL DEVICE (TYPICAL FOR 6)
2. CUT AND PATCH EXISTING FLOOR TO ACCOMMODATE FLOOR BOX AND CONDUIT.
3. PROVIDE WEATHER RESISTANT GFI RECEPTACLE AND CONNECT TO EXISTING WIRES. PROVIDE WEATHER PROOF IN-USE COVER.
4. CIRCUIT NUMBERS INDICATED ON PLAN FOR PANEL A ARE FOR REFERENCE PURPOSES ONLY. FIELD WIRING AVAILABLE IN ANY QUANTITY. EACH BRANCH CIRCUIT SHALL BE CONNECTED TO NEXT AVAILABLE 20A/1P CIRCUIT BREAKER WITH 2#12 + #12G - 3/4" C. UPDATE PANELBOARD DIRECTORY.



1 FIRST FLOOR COMMAND CENTER PARTIAL PLAN
E1.01 SCALE: 1/4" = 1'-0"

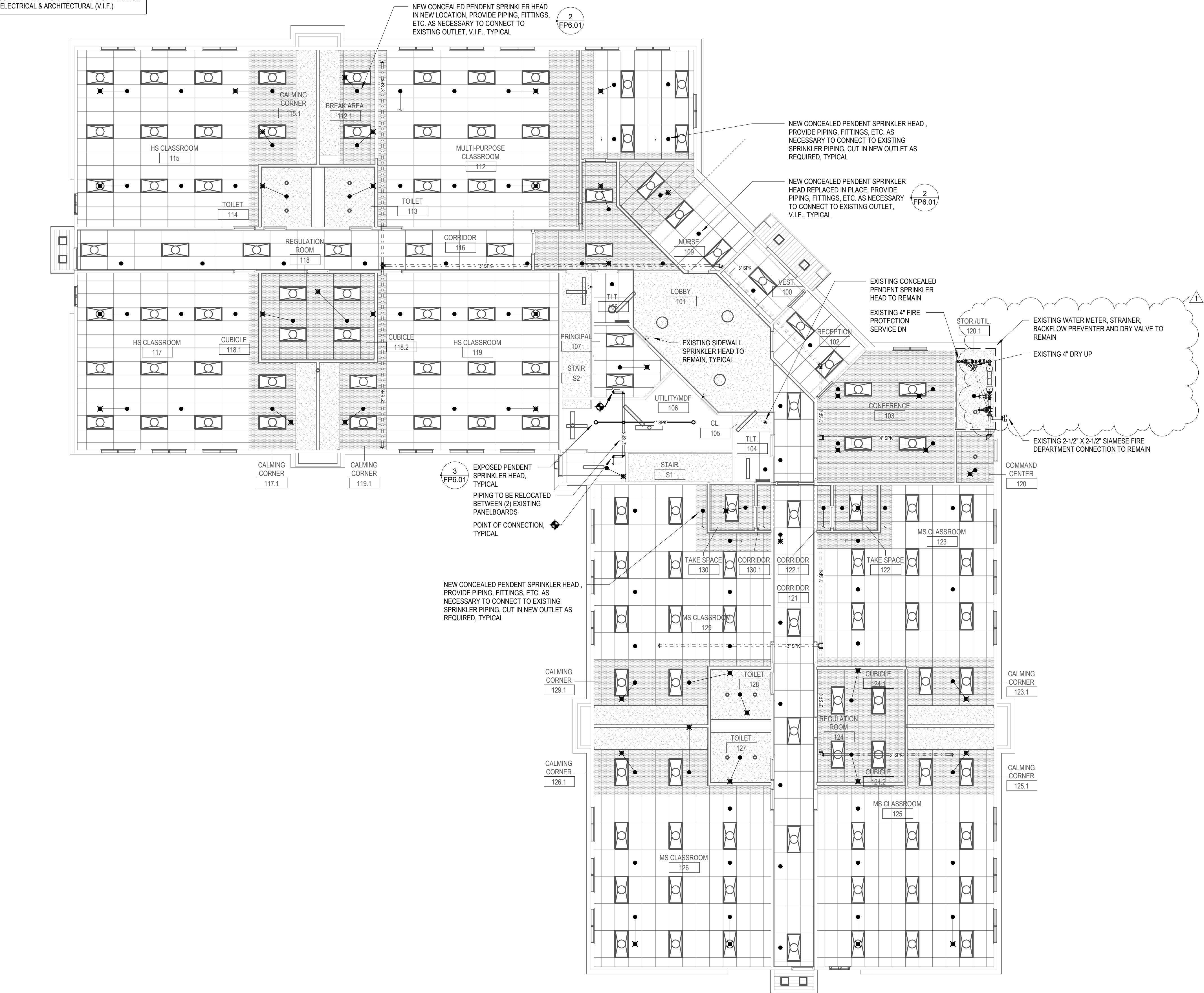


2 FIRST FLOOR UTILITY/MDF PARTIAL PLAN
E1.01 SCALE: 1/4" = 1'-0"

3 FIRST FLOOR PLAN
E1.01 SCALE: 1/8" = 1'-0"

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CONTRACTOR TO VERIFY IN FIELD EXISTING SPRINKLER PIPING ELEVATIONS AND RAISE OR LOWER AS NECESSARY TO ACCOMMODATE NEW OR EXISTING DUCTWORK, LIGHTING, ETC. PROVIDE ADDITIONAL PIPING, FITTINGS, HANGERS, ETC. AS NECESSARY AND COORDINATE NEW SPRINKLER PIPING ELEVATION WITH MECHANICAL, ELECTRICAL & ARCHITECTURAL (V.I.F.)



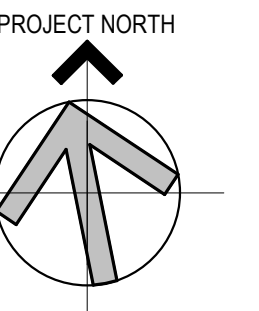
1 FIRST FLOOR CEILING PLAN
FP2.01 SCALE: 1/8" = 1'-0"

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Seals

Issues / Revisions	
No.	Description
1	01/09/2025 DESIGN DEVELOPMENT
1	01/09/2025 100% CONSTRUCTION DOCUMENTS
1	02/11/2025 ADDENDUM 2

Drawing Title
**FIRST FLOOR
CEILING PLAN -
FIRE
PROTECTION**

Project Manager:	Project No:	25101
Project Architect:	Production Leader:	
Project Designer: JPM	Peer Reviewer:	KBC

Drawing Number
FP2.01

SPRINKLER HEAD SCHEDULE												
SYMBOL	TYPE	STYLE	RESPONSE	COVERAGE	STANDARD COLORS REFER TO REMARKS	DISCHARGE COEFFICIENT (K)	ORIFICE	TEMPERATURE	MANUFACTURER		REMARKS	
									MODEL	SIN		
●	PENDENT	CONCEALED	QUICK	STANDARD	WHITE	4.2 K	1/2"	155 F*		VICTAULIC	--	
● ^D	DRY PENDENT	CONCEALED	QUICK	STANDARD	WHITE	4.2 K	1/2"	155 F*		V38		V3802
○	PENDENT	EXPOSED	QUICK	STANDARD	BRASS	4.2 K	1/2"	155 F*		VICTAULIC	--	
										V33		V3517
										RELIABLE		
									F1FR42	RA1413	PROVIDE HEAD GUARDS	
NOTE: FINAL COLOR SELECTION TO BE APPROVED BY ARCHITECT PRIOR TO INSTALLATION SPRINKLER TEMPERATURE RATING SHALL BE IN ACCORDANCE WITH NFPA 13, 5.2.5.1												

FIRE PROTECTION PIPE AND FITTING SCHEDULE									
DESCRIPTION	SIZE	PIPE		FITTING		REMARKS	ABBREVIATIONS		
		TYPE	SCHEDULE	TYPE	RATING		ABB	DESCRIPTION	
WET SPRINKLER PIPING	2" AND BELOW	STL-BLK	40	MIT/DIT	STD	--	DI MJ	DUCTILE IRON MECHANICAL JOINT	
							STD	STANDARD	
WET SPRINKLER PIPING	2-1/2" AND LARGER	STL-BLK	10	GRV	STD	--	MIT	MALLEABLE IRON THREADED	
							GRV	GROOVED JOINT SYSTEM FITTINGS/COUPLINGS	
DRY SPRINKLER PIPING	2" AND BELOW	STL-BLK	40	MIT/DIT	STD	ALL FITTINGS TO BE GALVANIZED	GA LV	GALVANIZED STEEL	
DRY SPRINKLER PIPING	2-1/2" AND LARGER	STL-BLK	40	GRV	STD	ALL FITTINGS TO BE GALVANIZED	DIT	DUCTILE IRON THREADED	

NOTE: ALL EXPOSED PIPING AND FITTINGS SHALL HAVE CUSTOM COLOR EPOXY PAINT CONCEALED PIPING MAY UTILIZE GROOVED FITTINGS

VALVE SCHEDULE									
DESCRIPTION	SIZE	TYPE				REMARKS	ABBREVIATIONS		
		OS&Y	BUTTERFLY	CHECK	BALL		CLASS	ABB	DESCRIPTION
UNDERGROUND FIRE PROTECTION SERVICE PIPING	ALL	OS&YF	BFVF	CVF	BVF	175 PSI	--	BFVF BUTTERFLY VALVE FLANGED BFVG BUTTERFLY VALVE GROOVED	
WET SPRINKLER PIPING	2" AND BELOW	OS&YT	BFVT	CVT	BVT	175 PSI	--	BFVT BUTTERFLY VALVE THREADED BVF BALL VALVE FLANGED - FULL PORT	
WET SPRINKLER PIPING	2-1/2" AND LARGER	OS&YG	BFVG	CVG	BVG	175 PSI	--	BVG BALL VALVE GROOVED - FULL PORT BVT BALL VALVE THREADED - 2-PIECE FULL PORT 400PSI	

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Seals

[illegible]

Drawing Title

**SCHEDULES -
FIRE
PROTECTION**

Project Manager:	Project No:	25101
Project Architect:	Production Leader:	
Project Designer:	JPM	Peer Reviewer: KBC

Drawing Number

FP5.01



Client/ Contractor

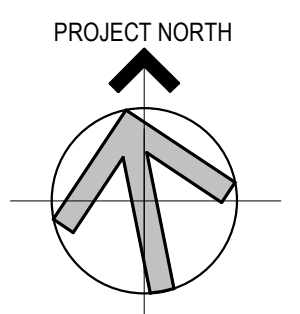
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Seals

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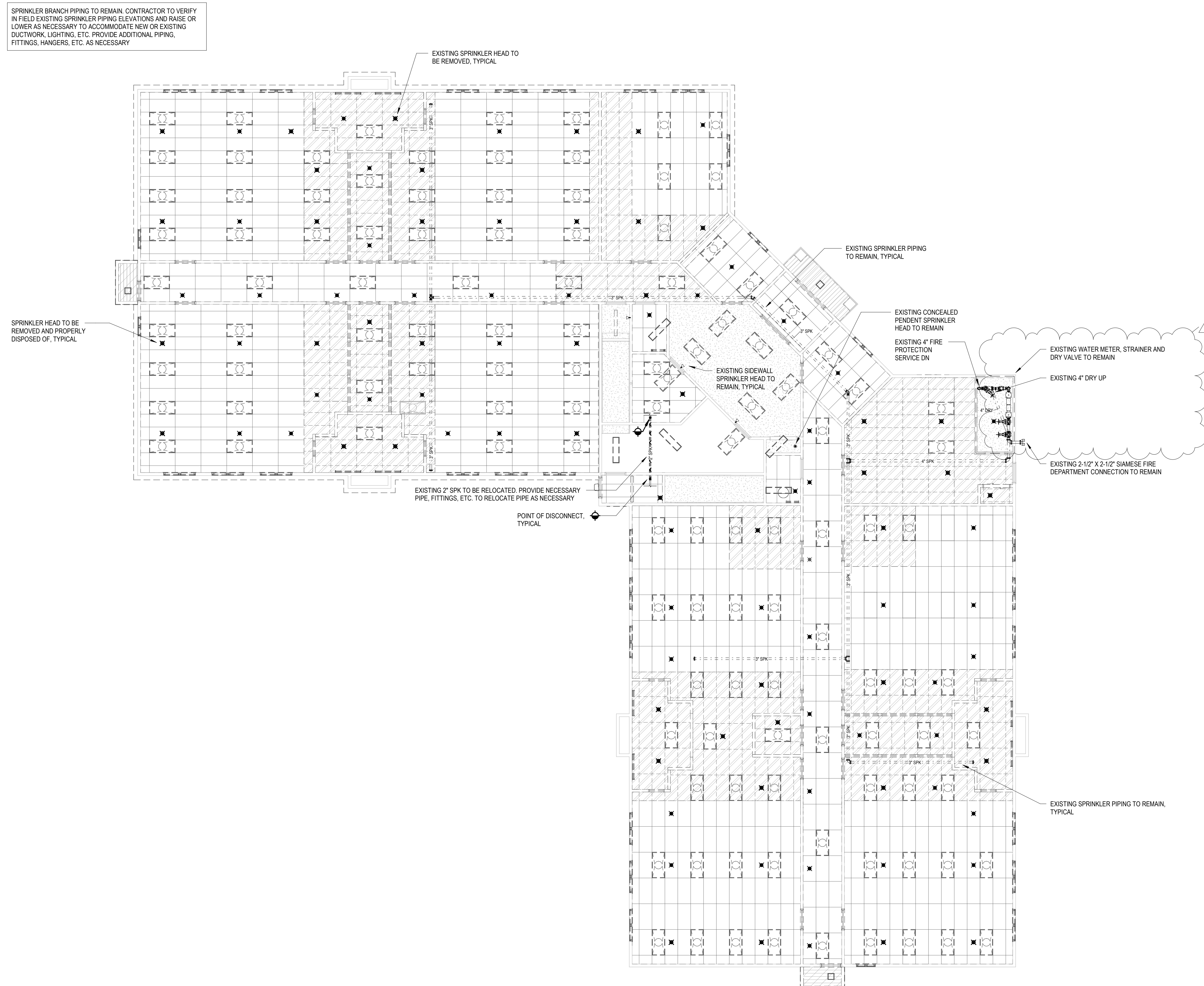
Drawing Title

**FIRST FLOOR
DEMOLITION -
FIRE
PROTECTION**

Project Manager:	Project No:	25101
Project Architect:	Production Leader:	
Project Designer:	JPM	Peer Reviewer: KBC

Drawing Number

FPD2.01



1 FIRST FLOOR DEMOLITION CEILING PLAN
FPD2.01 SCALE: 1/8" = 1'-0"

System name and number	RTU-1
Condition analyzed (impacts Ez, Vdz, Vpz and Vps)	Heating
All zones are included in the VRP calculation	Yes

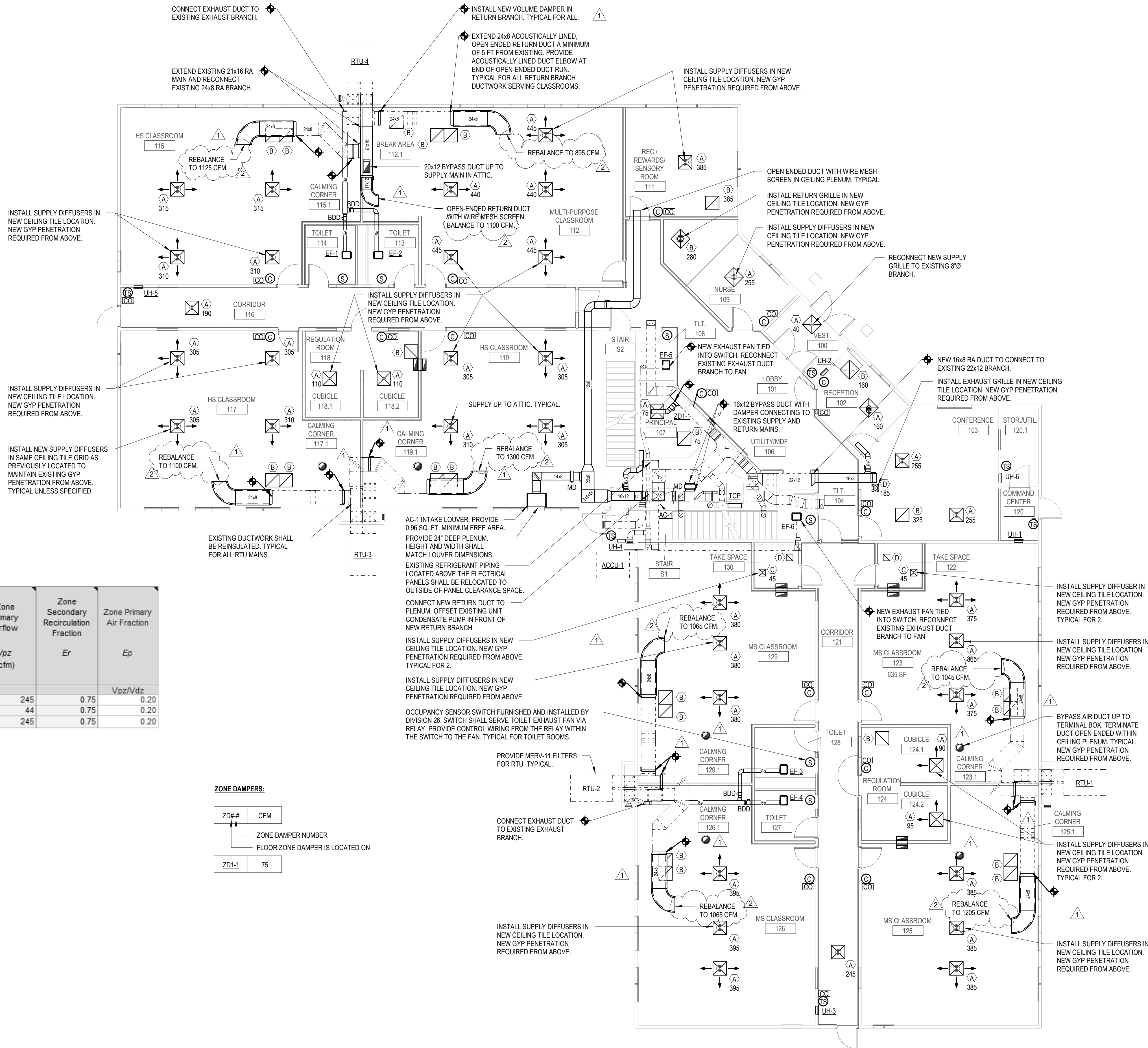
Zone Name and Number	Occupancy Category	Zone Floor Area Az (sq ft)	Are you using default value for zone population?	Zone Population Pz (people)	Zone Air Distribution Effectiveness Ez	Zone Outdoor Airflow Voz (cfm)	Zone Discharge Airflow Vdz (cfm)	Zone Primary Airflow Vpz (cfm)	Zone Secondary Recirculation Fraction Er	Zone Primary Air Fraction Ep
122 - TAKE SPACE	Office space	43	No	1.00	0.80	9.48	45	9	0.75	0.20
123 - MS CLASSROOM	Classrooms (age 9 plus)	738	No	9.00	0.80	223.20	1,115	223	0.75	0.20
124 - REGULATION ROOM + CUBICLES	Office space	206	No	3.00	0.80	34.20	185	37	0.75	0.20
125 - MS CLASSROOM	Classrooms (age 9 plus)	793	No	9.00	0.80	231.45	1,155	231	0.75	0.20
130 - TAKE SPACE	Office space	43	No	1.00	0.80	9.48	45	9	0.75	0.20

Add Rows	Delete Rows

System area	As	(sq ft)	1,823
System population	Ps	(people)	23.00
Sum of zone population	sum of Pz	(people)	23.00
Occupant diversity	D		1.00
Uncorrected outdoor air intake	Vou	(cfm)	406.24
System primary airflow (at condition analyzed)	Vps	(cfm)	2,545
Average outdoor air fraction	Xs		0.15

Which method from ASHRAE 62.1 is being used to determine system ventilation efficiency (Ev)?			Other (specify)
Ventilation efficiency	Ev		0.90
Outdoor air intake flow (required by 62.1)	Vot	(cfm)	451

Outdoor air intake flow provided (measured or design)	(cfm)	510



System name and number	RTU-3
Condition analyzed (impacts Ez, Vdz, Vpz and Vps)	Heating
All zones are included in the VRP calculation	Yes

Zone Name and Number	Occupancy Category	Zone Floor Area Az (sq ft)	Are you using default value for zone population?	Zone Population Pz (people)	Zone Air Distribution Effectiveness Ez	Zone Outdoor Airflow Voz (cfm)	Zone Discharge Airflow Vdz (cfm)	Zone Primary Airflow Vpz (cfm)	Zone Secondary Recirculation Fraction Er	Zone Primary Air Fraction Ep
117 - HS CLASSROOM	Classrooms (age 9 plus)	799	No	10.00	0.80	244.85	1,225	245	0.75	0.20
118 - REGULATION ROOM + CUBICLES	Office space	206	No	3.00	0.80	34.20	220	44	0.75	0.20
119 - HS CLASSROOM	Classrooms (age 9 plus)	802	No	10.00	0.80	245.30	1,225	245	0.75	0.20

Add Rows	Delete Rows

System area	As	(sq ft)	1,807
System population	Ps	(people)	23.00
Sum of zone population	sum of Pz	(people)	23.00
Occupant diversity	D		1.00
Uncorrected outdoor air intake	Vou	(cfm)	419.48
System primary airflow (at condition analyzed)	Vps	(cfm)	2,670
Average outdoor air fraction	Xs		0.15

Which method from ASHRAE 62.1 is being used to determine system ventilation efficiency (Ev)?			Other (specify)
Ventilation efficiency	Ev		0.90
Outdoor air intake flow (required by 62.1)	Vot	(cfm)	466

Outdoor air intake flow provided (measured or design)	(cfm)	535

1 FIRST FLOOR PLAN
M1.01 SCALE: 1/8" = 1'-0"

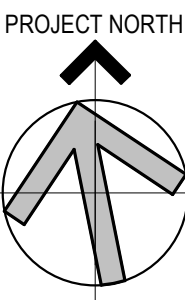
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Seals

Issues / Revisions		
No.	Date	Description
1	01/30/2026	ADDENDUM 1
2	02/11/2026	ADDENDUM 2

Drawing Title
**FIRST FLOOR
PLAN -
MECHANICAL**

Project Manager:	Project No:	25101
Project Architect:	Production Leader:	
Project Designer:	DD	Peer Reviewer: RVH

Drawing Number
M1.01

VALVE SCHEDULE											
DESCRIPTION	SIZE	TYPE						REMARKS	ABBREVIATIONS		
		GATE	GLOBE	CHECK	BALL	PLUG	BALAN.		CLASS	ABB.	DESCRIPTION
DOMESTIC COLD WATER	2" AND SMALLER	--	--	CVT / CVP	BVT / BVP	--	--	125 PSI	--	BVP	BALL VALVE PRESSED - 2-PIECE, FULL PORT, 400PSI, BRONZE
DOMESTIC HOT WATER	2" AND SMALLER	--	--	CVT / CVP	BVT / BVP	--	CBV	125 PSI	--	BVT	BALL VALVE THREADED 2-PIECE, FULL PORT, 400PSI, BRONZE
										CBV	CALIBRATED BALANCING VALVE - BRONZE
										CVP	CHECK VALVE PRESSED - BRONZE
										CVT	CHECK VALVE THREADED - BRONZE

PIPE AND FITTING SCHEDULE									
DESCRIPTION	SIZE	PIPE		FITTING		REMARKS			
		TYPE	SCHEDULE	TYPE	RATING		ABBREV.	DESCRIPTION	
SOIL, WASTE AND VENT ABOVE GROUND	ALL	PVC	40	DWV	STD	-	CI	CAST IRON	
DOMESTIC COLD WATER WITHIN BUILDING	2-1/2" AND BELOW	COPPER	TYPE L	CJS / PF	STD	HARD TEMPERED	CUS	WROUGHT COPPER SOLDER (55%)	
							MIT	MALLEABLE IRON THREADED	
DOMESTIC HOT WATER PIPING	2-1/2" AND BELOW	COPPER	TYPE L	CJS / PF	STD	HARD TEMPERED	PF	PRESSURE FITTINGS	
							STD	STANDARD	
DOMESTIC HOT WATER RECIRCULATION PIPING	2-1/2" AND BELOW	COPPER	TYPE L	CJS / PF	STD	HARD TEMPERED	STL-BLK	BLACK STEEL SEAMLESS	
NOTE: NO-HUB OR TRANSITION COUPLINGS ARE NOT PERMITTED BELOW GRADE, BELOW SLABS OR BURIED IN CONTACT WITH EARTH.									

SYSTEM	PIPE SIZE	PIPE INSULATION TYPE	PIPE INSULATION THICKNESS	FITTINGS, VALVES, FLANGES - INSULATION TYPE	REMARKS
DOMESTIC COLD WATER	ALL	MINERAL FIBER, ASJ, SSL	1"	MOLDED, PRE-FORMED MINERAL FIBER PVC JACKET	TYPE I
DOMESTIC HOT & HOT RECIRC WATER 109" THRU 140"	1-1/4" & LESS	MINERAL FIBER, ASJ, SSL	1"	MOLDED, PRE-FORMED MINERAL FIBER PVC JACKET	TYPE I

- FIBERGLASS INSULATION: THERMAL CONDUCTIVITY .22 TO .28 BTU x IN./H x FT x °F W/ 100°F MEAN TEMP. THICKNESS BASED ON IECC 2024
- REFER TO SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS
- ALL EXPOSED INDOOR PIPING/TUBING AND FITTINGS WITHIN OCCUPIED SPACES, CORRIDORS, MECHANICAL ROOMS AND OTHER NON-CONCEALED LOCATIONS SHALL BE FITTED WITH PVC FITTING COVERS AND PVC PIPE COVERS FROM THE FLOOR LEVEL TO 12" ABOVE THE FINISHED FLOORS, PLATFORMS, AND MEZZANINES. PVC FITTING AND PIPE COVERS SHALL BE 2650 FLAME AND SMOKE SPREAD RATED, COVERS AND JACKETING COLOR TO BE SELECTED BY ARCHITECT. PROVIDE TEMPLATE OF JACKET COLORS FOR THE ARCHITECT'S REVIEW.
- ELBOWS, TEES AND FITTINGS: CONCEALED OR EXPOSED, SHALL BE INSULATED WITH PRE-MOLDED, FACTORY FORMED FIBROUS GLASS WITH 3.5 PCF MINIMUM DENSITY AS MANUFACTURED BY HANFAB OR APPROVED EQUAL. ALL ELBOWS, TEES AND FITTINGS: CONCEALED OR EXPOSED, SHALL BE INSULATED WITH PVC FITTING COVERS. PVC FITTING COVERS SHALL BE 2650 FLAME AND SMOKE SPREAD RATED. SUBMIT COLOR CHART FOR SELECTION BY FACILITY. COLOR OF THE PVC JACKET SHALL BE DIFFERENT FOR EACH SYSTEM TYPE.
- DIAPER AND LOOSE FILL STYLE INSULATION ON PIPE FITTINGS IS NOT ACCEPTABLE. ELBOWS WITHOUT PVC COVERS ARE NOT ACCEPTABLE.

FIXTURE TAG	FIXTURE TYPE	FIXTURE MANUFACTURER MODEL, MODEL NO.	MATERIAL	DESCRIPTION	SUPPLY SIZE	TRAP SIZE	MINIMUM BRANCH SIZES			REMARKS	
							WASTE/ SANITARY	VENT	COLD WATER		HOT WATER
W1 	WATER CLOSET FLOOR MOUNTED FLUSH VALVE	WATER CLOSET: SLOAN ST-2029 FLUSH VALVE: SLOAN ROYAL 111-128 SEAT: BEMIS 1955CT000	VITREOUS CHINA COLOR: AS SELECTED BY ARCHITECT	ADA COMPLAINT, ELONGATED FLOOR MOUNTED WATER CLOSET, 1.28 GPF, 1-1/2" TOP SPUD, SYPHONJET FLUSHING 1.28 GPF, TOP SPUD, EXPOSED MANUAL HANDLE FLUSHMETER ELONGATED SEAT	1"	--	4"	2"	1-1/2"	--	--
L1 	LAVATORY WALL MOUNTED	LAVATORY: SLOAN SS-3006 FAUCET: KOHLER CORALAIS KR-15243-46A INSULATION KIT: TRUEBORG INSULATION KIT 1/2" COUPLER PEX-ALB WRAP MIXING VALVE: ACON ST70 SERIES	VITREOUS CHINA COLOR: AS SELECTED BY ARCHITECT	STANDARD AND ADA, 20-7/8" X 18" WALL HUNG LAVATORY, FRONT OVERFLOW, 4" CENTERSET FAUCET: MANUAL, METAL CONSTRUCTION, 0.5 GPM, LEVER HANDLES, ADA	3/8"	1-1/2"	1-1/2"	1-1/2"	--	1/2" THW	INSULATE TRAP & WATER PIPING BELOW LAVATORY WITH INSULATION KIT. MAXIMUM WATER CONSUMPTION REQUIREMENT: 0.5 GPM FLOW RESTRICTOR PROVIDE ADA OFFSET AT DRAIN AS REQUIRED PROVIDE ASSE 1070 MIXING VALVE
S1 	TWO COMP. SINK	FIXTURE: ELKAY CROSSTOWN ECTRJ31179T FAUCET: SYMMONS IDENTITY SK6710PD DRAIN: ELKAY LK35	18 GAUGE TYPE 304 STAINLESS STEEL	STAINLESS STEEL DOUBLE BOWL UNDERMOUNT SINK, 31-1/2" X 18-1/2" X 9", REAR CENTER DRAIN SINGLE HANDLE PULL-DOWN KITCHEN FAUCET, 1.5 GPM, TWO MODE WAND, 360 DEGREE SPOUT ROTATION, 25 INCH BRAIDED HOSE	1/2"	1-1/2"	1-1/2"	1-1/2"	1/2"	1/2"	--
S2	SINGLE COMP. SINK	FIXTURE: ELKAY LUSTERTONE ELUH1616 FAUCET: SYMMONS ORIGINS SK233 DRAIN: ELKAY LK39	18 GAUGE TYPE 304 STAINLESS STEEL	STAINLESS STEEL SINGLE BOWL UNDERMOUNT SINK, 18-1/2" X 18-1/2" X 7-7/8", REAR CENTER DRAIN SINGLE-LEVER FAUCET, METAL CONSTRUCTION, 1.5 GPM	1/2"	1-1/2"	2"	1-1/2"	1/2"	1/2"	MAXIMUM WATER CONSUMPTION REQUIREMENT: 1.5 GPM
EWC 	ELECTRIC WATER COOLER WALL HUNG	FIXTURE: ELKAY LZ3TLGBWSSK	STAINLESS STEEL	BOTTLE FILLING STATION & VERSATILE B-I-LEVEL ADA COOLER, 0.25 GPM, HIGH EFFICIENCY, FILTERED, REFRIGERATED, CHILLING CAPACITY OF 8.0 GPH OF 50°F DRINKING WATER, ANTIMICROBIAL LAMINAR FLOW, ELECTRONIC BOTTLE FILLER SENSOR WITH ELECTRONIC FRONT AND SIDE BUBBLER PUSHBAR ACTIVATION	3/8"	1-1/4"	1-1/2"	1-1/2"	1/2"	--	PROVIDE AND INSTALL WITH ELKAY LKAPR2G STEEL CANE APRON

UNIT NO.	LOCATION	SERVICE	PUMP TYPE	FLUID	GPM	HEAD (PSI)	ELECTRICAL				MANUFACTURER	REMARKS
							HP	VOLTAGE	PHASE	RPM	MODEL NO.	
RP-1	UTILITY/MDF 106	DOMESTIC HOT WATER RECIRCULATION	INLINE	DOMESTIC HOT WATER	2.56 GPM	5.26	1/25	120	1	N/A	GRUNDFOS UP-15-18-B5	INSTALL PER MANUFACTURER'S GUIDELINES

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[illegible]

Drawing Title

**SCHEDULES -
PLUMBING**

Project Manager:	Project No:	25101
Project Architect:	Production Leader:	
Project Designer:	JPM	Peer Reviewer: SF

Drawing Number

P5.01

Client/ Contractor

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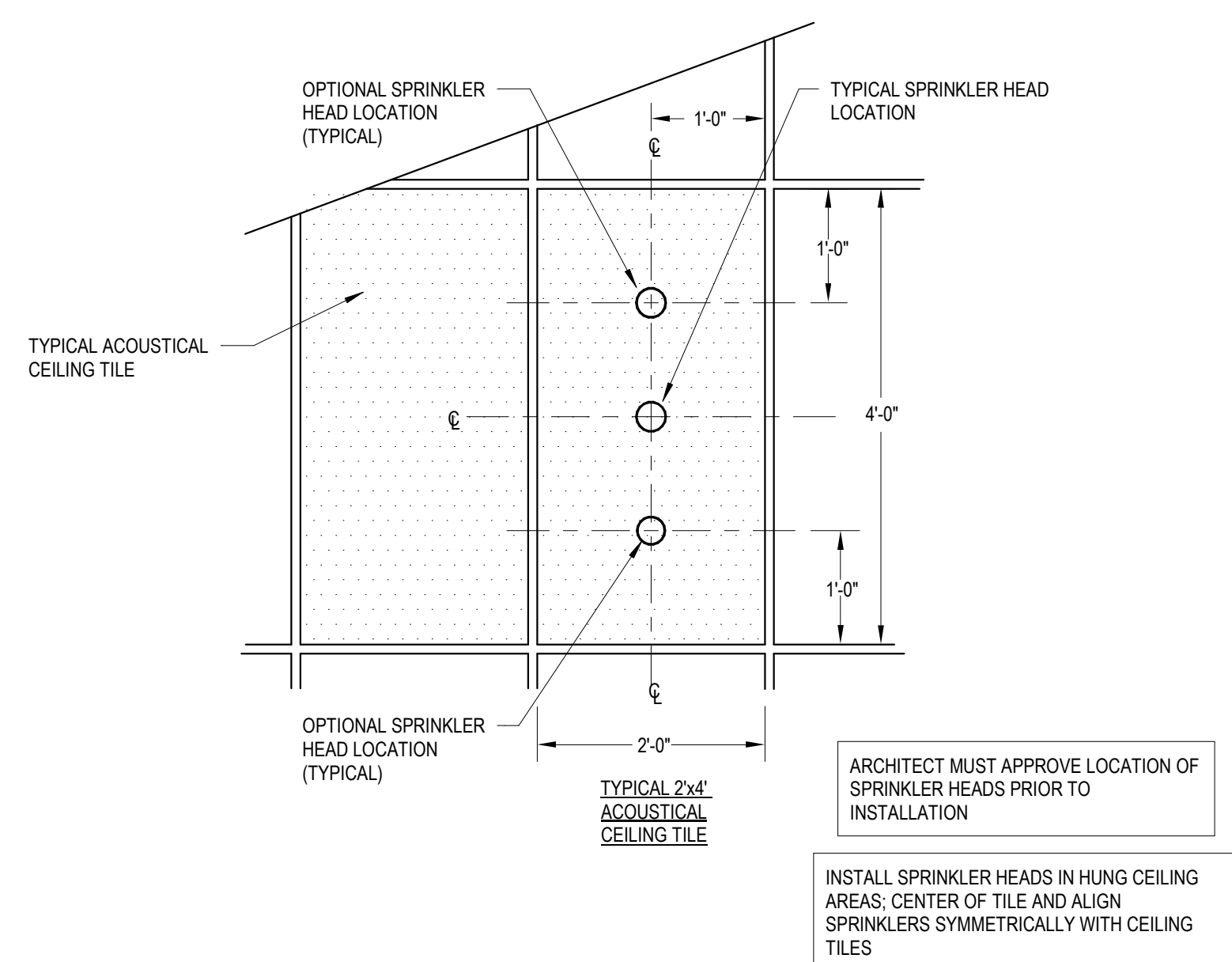
Drawing Title

DETAILS - FIRE
PROTECTION

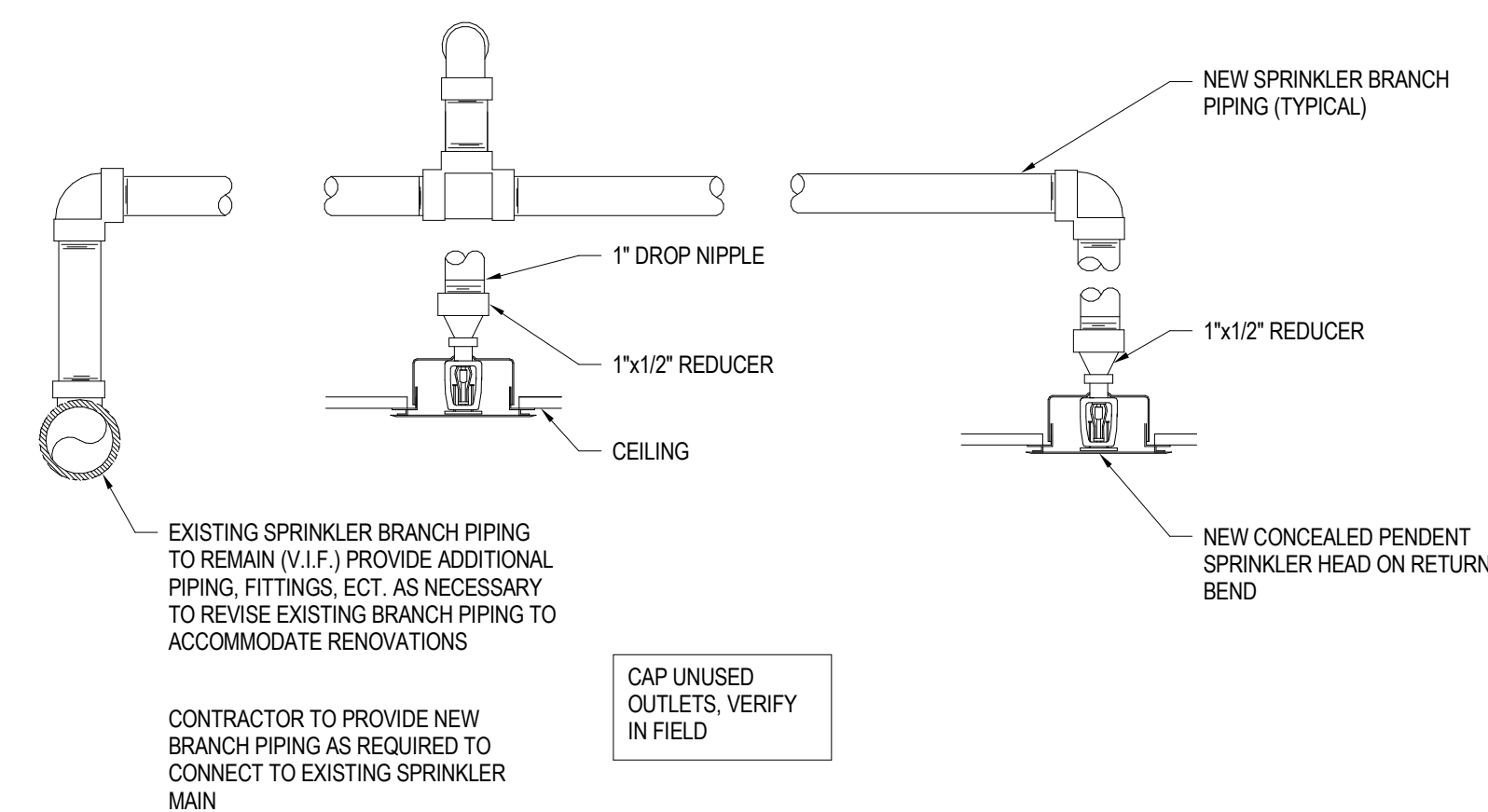
Project Manager:	Project No:	25101
Project Architect:	Production Leader:	
Project Designer:	JPM	Peer Reviewer: KBC

Drawing Number

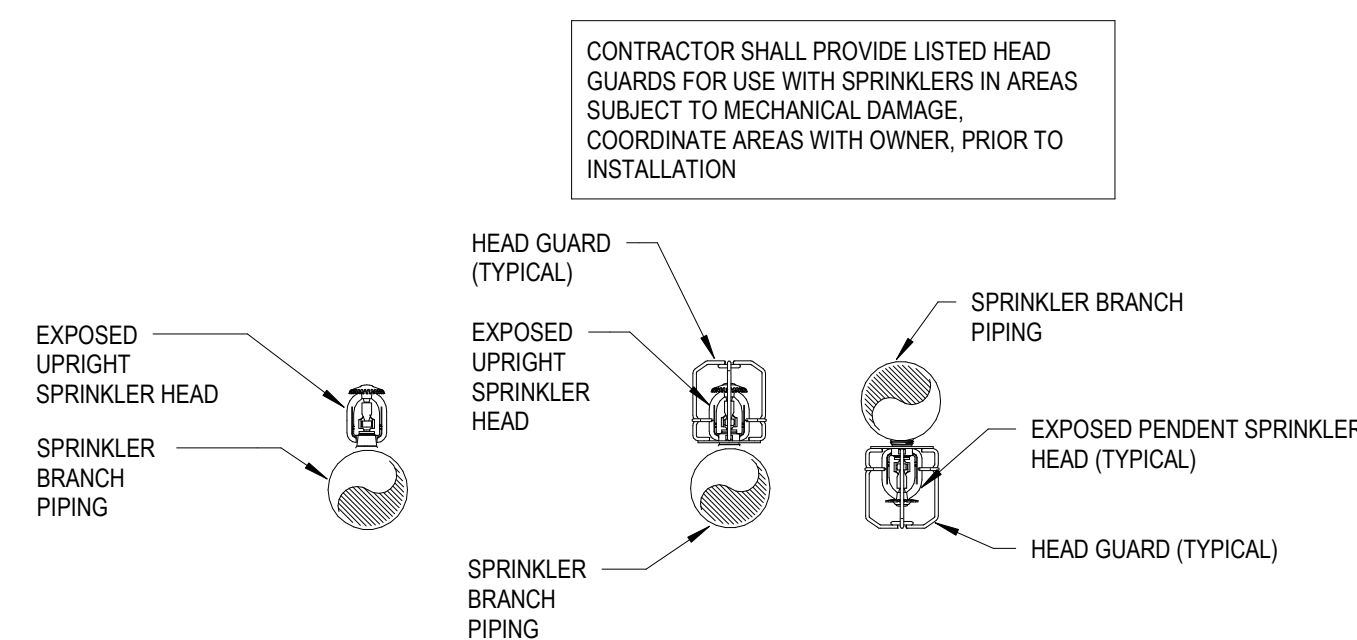
FP6.01



1 TYPICAL ACOUSTICAL TILE SPRINKLER HEAD LOCATION
FP6.01 SCALE: N.T.S.



2 RELOCATED CONCEALED PENDENT SPRINKLER HEAD
FP6.01 SCALE: N.T.S.



3 EXPOSED SPRINKLER HEADS
FP6.01 SCALE: N.T.S.