Boulder County Purchasing
1325 Pearl Street
Boulder, CO 80302
purchasing@bouldercounty.org

INVITATION TO BID
COVER PAGE

BID Number:	**6913-18**
BID Title:	**Boulder County Justice Center Addition Mechanical HVAC and Plumbing**
BID Questions Due:	**December 11, 2018**
Submittal Due Date:	**December 20, 2018**
Email Address:	purchasing@bouldercounty.org
Documents included in this package:	Bid Instructions Terms and Conditions Specifications Insurance and W-9 Requirements Submittal Checklist Bid Tab Signature Page

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INSTRUCTIONS

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1. **Purpose/Background**
   a. Boulder County Building Services is seeking proposals to provide Mechanical HVAC and Plumbing work for the Justice Center Addition located at 1777 6th Street in Boulder.
   b. This project is divided into two phases: "core and shell" and "tenant Interiors". Refer to section 011100 responsibility matrix in Attachment A for a detailed breakdown of work in each phase.
   c. The addition “core and shell” is currently under construction.
   d. This work is for the “tenant Interior” finish portion of the project only.

2. **Contract Documents:**
   a. This Request for Bids - BID #6913-18
   b. Specification Sections per Attachment A
   c. Building Service Sample Contract and General Conditions.
   d. Drawings per Attachment B.

3. **Summary of Work:** Provide a price for one and/or each item as listed below**:**

   Item #1 – Mechanical HVAC:
   Work consists of all labor and materials required for mechanical HVAC work including hydronic heat piping requirements.

   Item #2 – Plumbing**:**
   Work consists of all labor and materials required for Plumbing work including all fixtures and domestic hot and cold piping requirements.

   Item #3 – Combined HVAC and Plumbing:

4. **Written Inquiries**

   All inquiries regarding this BID will be submitted via email to the Boulder County Purchasing Office at purchasing@bouldercounty.org on or before 2:00 p.m. **December 11, 2018.** A response from the county to all inquiries will be posted and sent via email no later than **December 13, 2018.**

Please do not contact any other county department or personnel with questions or for information regarding this solicitation.

5. Submittal Instructions

BIDs are due at the Administrative Services Information Desk or email box (preferred) listed below, for time and date recording on or before **2:00 p.m. Mountain Time on** December 20, 2018. A bid opening will be conducted at 3:00 p.m. Mountain Time at county offices.

Your response can be submitted in the following ways. Please note that email responses to this solicitation are preferred, but are limited to a maximum of 25MB capacity. NO ZIP FILES ALLOWED. Electronic submittals must be received in the email box listed below. Submittals sent to any other box will NOT be forwarded or accepted. This email box is only accessed on the due date of your questions or proposals. Please use the Delivery Receipt option to verify receipt of your email. It is the sole responsibility of the proposer to ensure their documents are received before the deadline specified above. Boulder County does not accept responsibility under any circumstance for delayed or failed email or mailed submittals.

Email purchasing@bouldercounty.org**;** identified as **BID # 6913-18** in the subject line.

-OR-

US Mail One (1) unbound copy of your submittal, printed double-sided, 11 point, on at least 50% post-consumer, recycled paper must be submitted in a sealed envelope, clearly marked as **BID # 6913-18**, to the Administrative Services Information Desk located at 1325 Pearl Street, Boulder, CO 80302.

All BIDs must be received and time and date recorded by authorized county staff by the above due date and time. Sole responsibility rests with the bidder to see that their BID response is received on time at the stated location(s). Any BIDs received after due date and time will be returned to the bidder.

The Board of County Commissioners reserves the right to reject any and all BIDs, to waive any informalities or irregularities therein, and to accept the proposal that, in the opinion of the Board, is in the best interest of the Board and of the County of Boulder, State of Colorado.

Americans with Disabilities Act (ADA): If you need special services provided for under the Americans with Disabilities Act, contact the ADA Coordinator or the Human Resources office at (303) 441-3525 at least 48 hours before the scheduled event.

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TERMS AND CONDITIONS

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1. Bidders are expected to examine the drawing, specifications, schedule of delivery, and all instructions. Failure to do so will be at the bidder's risk.

2. Each bidder will furnish the information required in the Invitation to Bid.

3. The Contract/Purchase Order will be awarded to that responsible bidder whose submittal, conforming to the Invitation to Bid, will be most advantageous to the County of Boulder, based on best value not only price.

4. The County of Boulder reserves the right to reject any or all bids and to waive informalities and minor irregularities in bids received, and to accept any portion of or all items proposed if deemed in the best interest of the County of Boulder to do so.

5. No submittal will be withdrawn for a period of thirty (30) days subsequent to the opening of bids without the consent of the County Purchasing Agent or delegated representative.

6. A signed purchase order or contract furnished to the successful bidder results in a binding contract without further action by either party.

7. Late or unsigned bids will not be accepted or considered. It is the responsibility of bidders to ensure that the bid arrives at the Administrative Services Information Desk prior to the time indicated in the "Invitation to Bid."

8. The proposed price will be exclusive of any Federal or State taxes from which the County of Boulder is exempt by law.

9. Any interpretation, correction or change of the bid documents will be made by Addendum. Interpretations, corrections and changes of the bid documents made in any other manner will not be binding, and bidder will not rely upon such interpretations, corrections and changes. The County's Representative will not be responsible for oral clarification.

10. Confidential/Proprietary Information: Bids submitted in response to this "Invitation to Bid" and any resulting contract are subject to the provisions of the Colorado Public (Open) Records Act, 24-72-201 et.seq., C.R.S., as amended. Any restrictions on the use or inspection of material contained within the bid and any resulting contract will be clearly stated in the bid itself.

Confidential/proprietary information must be readily identified, marked and separated/packaged from the rest of the bid. Co-mingling of confidential/proprietary and other information is NOT acceptable. Neither a bid, in its entirety, nor bid price information will be considered confidential/proprietary. Any information that will be included in any resulting contract cannot be considered confidential.

11. Boulder County promotes the purchase/leasing of energy efficient, materials efficient and reduced toxic level products where availability, quality and budget constraints allow. Bidders are expected whenever possible to provide products that earn the ENERGY STAR and meet the ENERGY STAR specifications for energy efficiency with power management features enabled. Bidders are encouraged to offer products and equipment with post-consumer recycled-content materials. Products should be packaged and delivered with a minimum amount of recycled packaging that adequately protects the product, but is not excessive.

12. Pursuant to Colorado law (House Bill 1292), in any bidding process for public works in which a bid is received from a non-resident bidder who is from a state that provides a percentage bidding preference, a comparable percentage disadvantage will be applied to the bid of that bidder. Bidders may obtain additional information from the Department of Personnel's website: http://www.colorado.gov/dpa/.

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INSURANCE AND W-9 REQUIREMENTS

PAYMENT & PERFORMANCE BONDS

Both a payment and a performance bond are required for this project if the amount of work exceeds $50,000 and must each equal 100% of the proposed cost. Please include the cost of this bonding into the total proposed cost.

INSURANCE REQUIREMENTS

General Liability	$1,000,000 Each Occurrence $2,000,000 General Aggregate $2,000,000 Products Completed Operations Aggregate 3 years Products/Completed Operations
Excess or Umbrella	$1,000,000
Automobile Liability	$1,000,000 Each Accident *Including Hired & Non-Owned Auto
Worker's Compensation and Employer's Liability	Statutory limits

Note that the above insurance amounts are the minimum required for this project. **Proof of current insurance must be provided with your proposal in the form of a sample certificate or your proposal will be deemed non-responsive.** If you require a waiver of insurance requirements (e.g. Workers' Compensation and sole proprietorships) you may request one in your response with an explanation.

New certificates will be requested if the contract process takes more than 30 days after an award.

W-9 REQUIREMENT

Provide a copy of your business's W-9 with your proposal.

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SUBMITTAL SECTION

The bidder's attention is especially called to the items listed below, which must be submitted in full as part of the BID. Failure to submit any of the documents listed below as a part of your BID, or failure to acknowledge any addendum in writing with your BID, or submitting a bid on any condition, limitation or provision not officially invited in this Invitation to Bid (BID) may be cause for rejection of the BID.

THIS CHECKLIST MUST BE SUBMITTED AS PART OF YOUR BID PACKAGE: Bidder will check each box indicating compliance:

INCLUDED	ITEM
	Name and Address of the Partners and Subcontractors if applicable
	A detailed project schedule with an all-inclusive total cost
	Information on the relevant experience of key personnel
	Submit a copy of any contract you would require to be executed in this process
	Submit three references for similar projects your company has completed within the last three years and contact information
	Insurance Certificate
	W-9
	Signature Page
	Addendum Acknowledgement(s) (If Applicable)

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BID TAB

Provide a price for one and/or each item as listed below. Work shall be awarded based on the most responsible Bid that best satisfies the requirements of the project, not necessarily on the lowest price. Boulder County reserves the right to make the award on the basis of the Bid deemed most favorable to the County, to waive any informalities, or to reject any or all Bids.

All work described in the Drawings, Specifications and Addenda for this project:

ITEM #1: Mechanical HVAC - Work consists of all labor and materials required for mechanical HVAC work including hydronic heat piping requirements.

_____dollars ($_____)

Duration_____ Working Days

ITEM #2: Plumbing - Work consists of all labor and materials required for Plumbing work including all fixtures and domestic hot and cold piping requirements.

_____dollars ($_____)

Duration_____ Working Days

Item #3 –Combine Mechanical HVAC and Plumbing are awarded to same contractor.

_____dollars ($_____)

Alternates: Provide a separate page for any proposed alternates, with description of alternate and impact to cost or timing of work.

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SIGNATURE PAGE

Contact Information	Response
Company Name including DBA	
List Type of Organization (Corporation, Partnership, etc.)	
Name, Title, and Email Address of Person Authorized to Contract with Boulder County	
Company Address	
Company Phone Number	
Company Website	

By signing below I certify that:
I am authorized to bid on my company's behalf**.**
I am not currently an employee of Boulder County.
None of my employees or agents is currently an employee of Boulder County.
I am not related to any Boulder County employee or Elected Official.
(Sole Proprietorships Only) I am not a Public Employees' Retirement Association (PERA) retiree.

_____ _____

Signature of Person Authorized to Bid on Company's Behalf **Date**

Note: If you cannot certify the above statements, please explain in a statement of explanation**.**

Attachment #A

Boulder County Justice Center Addition
Mechanical HVAC and Plumbing

DIVISION 01 – GENERAL REQUIREMENTS
011000 SUMMARY
011100 RESPONSIBILITY MATRIX
012600 CONTRACT MODIFICATION PROCEDURES
012900 PAYMENT PROCEDURES
013300 SUBMITTAL REQUIREMENTS
014000 QUALITY REQUIREMENTS
015000 TEMPORARY FACILITIES AND CONTROLS
016000 PRODUCT REQUIREMENTS
017329 CUTTING AND PATCHING
017700 CLOSEOUT PROCEDURES
017823 OPERATIONS AND MAINTENANCANCE

DIVISION 22 - PLUMBING
220000 BASIC PLUMBING REQUIREMENTS
220500 COMMON WORK RESULTS FOR PLUMBING
220516 PIPE EXPANSION JOINTS
220519 METERS AND GAGES FOR PLUMBING PIPING
220523 GENERAL-DUTY VALVES FOR PLUMBING PIPING
220529 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
220553 IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
220700 PIPING INSULATION
221116 DOMESTIC WATER PIPING
221119 DOMESTIC WATER PIPING SPECIALTIES
221316 SANITARY WASTE AND VENT PIPING
221319 SANITARY WASTE PIPING SPECIALTIES
221423 STORM DRAINAGE PIPING SPECIALTIES
221429 SUMP PUMPS
224000 PLUMBING FIXTURES

DIVISION 23 - HEATING VENTILATING AND AIR CONDITIONING
230000 BASIC MECHANICAL REQUIREMENTS
230500 COMMON WORK RESULTS FOR HVAC
230529 SUPPORTS AND ANCHORS
230553 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
230593 TESTING, ADJUSTING, AND BALANCING FOR HVAC
230700 MECHANICAL INSULATION
230800 MECHANICAL COMMISSIONING
230900 DIRECT DIGITAL CONTROL SYSTEM
231123 NATURAL-GAS PIPING
232113 HYDRONIC PIPING
233113 METAL DUCTWORK
233300 DUCTWORK ACCESSORIES
233413 AIR HANDLING FANS
233600 AIR TERMINALS
233650 SOUND ATTENUATORS
233713 AIR OUTLETS AND INLETS
238126 SPLIT SYSTEM AIR CONDITIONERS
238200 TERMINAL HEAT UNITS

SECTION 011000 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY OF WORK (Mechanical HVAC and Plumbing **Bid #6913-18**):

A. Project Identification: As follows: Justice Center Addition - Interior Finish
   1. Location: Boulder County Justice Center
      1777 6th Street
      Boulder, CO 80302

   2. Owner: Boulder County
      Owners Representative: Seth
      Jacobs
   3. Description: This project encompasses the interior tenant finish portion of an addition under construction; the exterior shell work is being constructed by Milender White General Contractors. Work under this project for interior finish will be contracted directly with Boulder County.

B. Contract Documents, were prepared by the Boulder County Building Services Division, Consulting Engineers, etc, and other consultants as noted
   Design Team:
      1. Architect: Short Elliott Hendrickson, Inc. (SEH)
      2. MEP: BCER
      3. Structural: JVA
      4. Civil: JVA
      5. Landscape Architecture: SEH

C. The Work consists of all labor and materials required for the following items, as described in the Contract Documents. See specifications and drawings for base bid scope of work. The

   Item #1 – Mechanical HVAC:
   Work consists of all labor and materials required for mechanical HVAC work including hydronic heat piping requirements.

   Item #2 – Plumbing**:**
   Work consists of all labor and materials required for Plumbing work including all fixtures and domestic hot and cold piping requirements.

1.2 ACCESS TO SITE

A. General: During construction, contractor shall have full use of addition site, but limited use of existing occupied building. Subcontractor's use of premises is limited only by Owner's right to perform work or employ other contractors on portions of Project.

B. Use of Site: Limit use of Project site to **work in areas** indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
   1. Driveways, Walkways and Entrances: Keep entry driveways and personnel entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times.
      a. Schedule deliveries to minimize use of driveways and entrances by construction operations.

b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.3 WORK RESTRICITIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. **Boulder County (owner) will be acting as the General Contractor.** The work to be done by Boulder County crews include:
   a. Electrical
   b. Low voltage wiring and devices
   c. HVAC Controls.

2. Boulder County will be the Building Permit holder. Contractors will not be responsible for permit fees, but may be responsible for other fees. Contact the City of Boulder for information on any such fees.

B. **On-Site Work Hour**s: Limit work in the existing building to normal business working hours of 7:00 a.m. to 6:00 p.m., Monday through Friday, except as otherwise indicated.

C. **Existing Utility Interruptions**: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
   1. Notify **Owner** not less than 72 hours in advance of proposed utility interruptions

D. Parking: The Justice Center parking is extremely limited and only available to people who have business with the 20th Judicial District or City of Boulder Municipal Courts.
   1. Contractor will be provided one parking spot at the Justice Center.
   2. Contractor or their employees will not be allowed to park in the parking lot on 6th Street directly across from the Justice Center. Vehicles identified as being connected to the construction project and parked in this lot can expect to be ticketed by the Boulder County Sheriff officers that are stationed at the Justice Center.

E. Contractor shall consult with County crew supervisor to determine locations for staging, if necessary.

F. Boulder County is strongly committed to the recycling of construction and waste materials. The County will provide recycling areas or containers as required.

G. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
   1. Notify **Owner** not less than 72 hours in advance of proposed disruptive operations.

H. Nonsmoking Building: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor air intakes.

I. Controlled Substances: Use of tobacco products and other controlled substances within the existing building or on the Project site is not permitted.

J. Employee Identification: Owner will provide identification tags for Contractor personnel working on the Project site. Require personnel to utilize identification tags at all times.

K. Employee Screening: Comply with Owner's requirements regarding drug and background screening of Contractor personnel working on the Project site.
   1. Maintain list of approved screened personnel with Owner's Representative.

END OF SECTION 011000

RESPONSIBILITY MATRIX (CORE & SHELL -VS- TENANT INTERIORS) VOLUME 1			
DIVISION	**DESCRIPTION**	**CS**	**TI**
01	General Conditions	**X**	**X**
02	Selective Demolition	**X**	
03	Concrete	**X**	
04	Masonry	**X**	
05	Structural Steel Framing	**X**	
	Steel Joist Framing	**X**	
	Steel Decking	**X**	
	Cold-Formed Framing (Exterior Walls, Rated Shafts, Temporary Framing)	**X**	
	Cold-Formed Framing (Interior Non-Structural Framing)		**X**
	Metal Fabrications (Handrails, Guards, Stairs - Interior and Exterior)	**X**	
06	Sheathing (Exterior Building Envelope, Temporary Sheathing)	**X**	
	Sheathing (Interior)		**X**
	Cabinetry, Countertops, Interior Woodwork		**X**
07	Cold Fluid-Applied Waterproofing	**X**	
	Thermal Insulation	**X**	
	Composite Metal Panels	**X**	
	Metal Panels	**X**	
	TPO Roofing	**X**	
	Sheet Metal Flashing and Trim	**X**	
	Exterior Sealants and Caulking, Fire Sealant and Caulking	**X**	
	Air Barriers and Vapor Barriers	**X**	
	Temporary Sound Attenuation Insulation	**X**	
	Permanent Interior Sound Attenuation Insulation		**X**
	Interior Sealants and Caulking		**X**
08	Exterior Openings and Fire Rated Openings (Including Glazing and Hardware)	**X**	
	Interior Non-Rated Openings (Including Glazing and Hardware)		**X**
	Skylights	**X**	
09	Exterior and Building Envelope Gypsum Applications	**X**	
	All Fire Rated and Temporary Gypsum Applications	**X**	
	Non-Rated Interior Gypsum Applications and Iterior Layer of Exterior Walls		**X**
	All Exterior Finishes	**X**	
	All Interior Finishes		**X**
10	All Exterior Specialties	**X**	
	All Interior Specialties		**X**
11	Equipment		**X**
12	Furnishings		**X**
14	Hydraulic Elevator	**X**	

LEGEND

CS	Core & Shell
TI	Tenant Interiors

RESPONSIBILITY MATRIX (CORE & SHELL -VS- TENANT INTERIORS) VOLUME 2			
21	Fire Sprinkler Design and Construction	**X**	
22	All Plumbing Work to Termination Points where Indicated in Drawings	**X**	
	All Plumbing Work from Termination Points where Indicated in Drawings		**X**
	All Interior Plumbing and Fixtures		**X**
23	All HVAC Work to Terminatin Points where Indicated in Drawings	**X**	
	All HVAC Work from Termination Points where Indicated in Drawings		**X**
	Temporary HVAC	**X**	
	Direct Digital Control System (By Boulder County)		**X**
26	Electrical (All Electrical Work to be Performed by Boulder County)	**X**	**X**
27	Communications (By Boulder County)		**X**
28	Electronic Safety and Security Including Fire Alarm (By Boulder County)	**X**	**X**
31	Earthwork	**X**	
32	Exterior Improvements Unless Noted Otherwise	**X**	
	Site Furnishings - Purgola	**X**	
	Site Furnishings Except Purgola (By Boulder County)		**X**
33	Utilities	**X**	

LEGEND

CS	Core & Shell
TI	Tenant Interiors

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other work of the Contract.

C. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Sunshades and Light Shelves (Part of Core and Shell).

1. Base Bid: Provide integrated sunshade accessory for storefront window system where shown in drawings.
2. Alternate: Provide integrated sunshade accessory and integrated light shelf accessory for storefront window system where shown in drawings.

B. Alternate No. 2: Exterior Balcony Railing

1. Base Bid: Provide balcony railing per drawing detail 1/A103.
2. Alternate: Provide balcony railing similar to drawing detail 1/A103 except with frameless glass infill panel in lieu of wire mesh panel screen.

C. Alternate No. 3: Exterior Glazing

1. Base Bid: Provide GL-2 and GL-3 1-5/16” Laminated Insulated glazing types with Kawneer curtainwall 1600UT frames as specified.
2. Alternate: Provide 1” Insulating glazing (GL-1) and corresponding spandrel units in lieu of specified GL-2 and GL-3. Provide Kawneer curtainwall 1600 frames in lieu of 1600UT frames.

END OF SECTION 012300

SECTION 01 26 00 CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Administrative and procedural requirements for handling and processing Contract modifications:
   1. Request for Interpretation
   2. Minor Changes in Work
   3. Work Changes Proposal Requests
   4. Construction Change Directive
   5. Change Order Procedures

1.02 REQUEST FOR INTERPRETATION (RFI)

A. Contractor's tool to request information.

B. Submit on form at end of this Section or on Contractor's form approved by Architect.

C. If latent or unforeseen conditions require modifications to Contract, Contractor may propose changes by submitting request for a change to Architect.
   1. Provide a complete description of proposed change, including a statement outlining reasons for the change and the effect of the change on the Work.
   2. Indicate the effect of the proposed change on Contract Sum and Contract Time.
   3. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   4. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of Contract Time.
   6. Comply with requirements in Section 01 25 13 if proposed change requires substitution of a product or system for product or system specified.

D. Report to Architect on this form any Contract Document requirements known to be in nonconformance with applicable laws, statutes, ordinances, building codes, and rules and regulations.

1.03 MINOR CHANGES IN WORK

A. Architect will issue through Construction Manager supplemental instructions authorizing minor changes in Work, not involving adjustment to Contract Sum or Contract Time, on AIA Document G710 "Architect's Supplemental Instructions.

1.04 WORK CHANGES PROPOSAL REQUESTS (PR)

A. Owner-Initiated:
   1. Architect or Construction Manager will issue a detailed description of proposed changes in Work that may require adjustment to Contract Sum or Contract Time. If necessary, the description will include supplemental or revised Drawings and specifications.

2. Proposal Requests are for information only. Do not consider them instructions either to stop Work in progress or to execute the proposed change.
3. After receipt of Proposal Request, submit a quotation estimating cost adjustments to Contract Sum and Contract Time necessary to execute change.
   a. Submit response within time specified in Proposal Request.
   b. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
   c. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
   d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of Contract Time.

1.05 CONSTRUCTION CHANGE DIRECTIVE

A. Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
   1. Contains a complete description of change in the Work and designates method to be followed to determine change in Contract Sum or Contract Time.
   2. Refer to General Conditions for further information on Construction Change Directives.

B. Documentation: Maintain detailed records on a time and material basis of work required by Construction Change Directive.

C. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to Contract.

1.06 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor.

B. Proposed Work is not authorized until complete execution of Change Order.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

REQUEST FOR INTERPRETATION

Project: _____ RFI No.: _____

SEH Project Manager: _____ SEH Project No.: _____

Requested by: _____ Date: _____

Specification Section: Paragraph: Drawing Reference: Detail:

Request:

Architect Response: **Date Received:** _____

See PR # _____

☐ Attachments

Signed: _____ Date Returned: _____

Distribution: ☐ Owner ☐ Consultant ☐ Contractor ☐ Other _____

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SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Correlate line items in the schedule of values with other required administrative forms and schedules, including the following:

    a. Application for Payment forms with continuation sheets.
    b. Submittal schedule.
    c. Items required to be indicated as separate activities in Contractor's construction schedule.

2. Submit the schedule of values to Architect at earliest possible date but no later than 7 days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.
4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values correlated with each element.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

    a. Project name and location.
    b. Name of Architect.
    c. Architect's project number.
    d. Contractor's name and address.

e. Date of submittal.

2. Arrange schedule of values consistent with format of **AIA Document G703**
3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:

   a. Related Specification Section or Division.
   b. Description of the Work.
   c. Name of subcontractor.
   d. Name of manufacturer or fabricator.
   e. Name of supplier.
   f. Change Orders (numbers) that affect value.
   g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

      1) Labor.
      2) Materials.
      3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of **five** percent of Contract Sum.

5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

   a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

7. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
9. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate owner payments or deposits, if any, and balance to be paid by Contractor.
10. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

11. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Times: Progress payments shall be submitted to Architect by the 21st of the month. The period covered by each Application for Payment is one month, ending on the **last day of the month**.

1. Submit draft copy of Application for Payment 7 days prior to due date for review by Architect.

D. Application for Payment Forms: Use **AIA Document G702/CMa and AIA Document G703** as form for Applications for Payment.

E. Application for Payment Forms: Use forms provided by Owner for Applications for Payment. Sample copies are included in the Project Manual.

F. Application for Payment Forms: Use forms acceptable to **Architect** and Owner for Applications for Payment. Submit forms for approval with initial submittal of schedule of values.

G. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. **Architect** will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

H. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.

2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Materials previously stored and included in previous Applications for Payment.
    b. Work completed for this Application utilizing previously stored materials.
    c. Additional materials stored with this Application.
    d. Total materials remaining stored, including materials with this Application.

I. Transmittal: Submit **three** signed and notarized original copies of each Application for Payment to **Architect** by a method ensuring receipt **within 48 hours**. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

J. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

K. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
2. When an application shows completion of an item, submit conditional final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

L. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
2. Schedule of values.

3. Contractor's construction schedule (preliminary if not final).
4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
5. Products list (preliminary if not final).
6. Schedule of unit prices.
7. Submittal schedule (preliminary if not final).
8. List of Contractor's staff assignments.
9. List of Contractor's principal consultants.
10. Copies of building permits.
11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
12. Initial progress report.
13. Report of preconstruction conference.
14. Certificates of insurance and insurance policies.
15. Performance and payment bonds.
16. Data needed to acquire Owner's insurance.

M. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

N. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

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SECTION 013300 - SUBMITTAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as action submittals.

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as informational submittals.

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

A. SUBMITTAL SCHEDULE
   1. Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Architect and additional time for handling and reviewing submittals required by those corrections.
      a. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

b. Initial Submittal: Submit concurrently with start-up construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
c. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
1) Submit revised submittal schedule to reflect changes in current status and timing for submittals.

2. Format: Arrange the following information in a tabular format:

a. Scheduled date for first submittal.
b. Specification Section number and title.
c. Submittal category: Action, informational.
d. Name of subcontractor.
e. Description of the Work covered.
f. Scheduled date for Architect's final release or approval.
g. Scheduled dates for purchasing.
h. Scheduled dates for installation.
i. Activity or event number.

B. THREE-WEEK LOOK AHEAD SCHEDULE
1. If submittal schedule is not available, Contractor shall include upcoming submittals in the Three-Week Look Ahead Schedule. This schedule shall be submitted weekly to the Architect, immediately following weekly construction progress meetings, whether or not the Architect was in attendance. The Three-Week Look Ahead Schedule shall be submitted to the Architect each week for the duration of all construction activities on site.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: When requested, Electronic copies of CAD Drawings of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.

1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings **and Project record drawings**.

a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
b. Digital Drawing Software Program: The Contract Drawings are available in Revit 2014 or Autoacad.
c. Contractor shall execute a data licensing agreement in the form of **AIA Document C106, Digital Data Licensing Agreement**

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Submit all items required for each Specification Section in one single submittal. Architect will reject and not review submittals that are not complete, including all requirements of the Section into one single submittal. When submittals are submitted at different times for products, certifications, warranties, accessories, etc. listed in the same Section, the
3. Informational submittals shall be clearly identified as such.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. **Architect reserves** the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on **Architect's** receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow **15** days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. **Architect** will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow **15** days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is required, allow **21** days for initial review of each submittal.

5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to **Architect** before being returned to Contractor.

D. Identification and Information: Place a permanent label or title block on each paper copy submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information for processing and recording action taken:

    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Construction Manager.
    e. Name of Contractor.
    f. Name of subcontractor.
    g. Name of supplier.
    h. Name of manufacturer.
    i. Submittal number or other unique identifier, including revision identifier.

1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).

j. Number and title of appropriate Specification Section.
k. Drawing number and detail references, as appropriate.
l. Location(s) where product is to be installed, as appropriate.
m. Other necessary identification.

E. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
4. Include the following information on an inserted cover sheet:

a. Project name.
b. Date.
c. Name and address of Architect.
d. Name of Contractor.
e. Name of firm or entity that prepared submittal.
f. Name of subcontractor.
g. Name of supplier.
h. Name of manufacturer.
i. Number and title of appropriate Specification Section.
j. Drawing number and detail references, as appropriate.
k. Location(s) where product is to be installed, as appropriate.
l. Related physical samples submitted directly.
m. Other necessary identification.

5. Include the following information as keywords in the electronic file metadata:

a. Project name.
b. Number and title of appropriate Specification Section.
c. Manufacturer name.
d. Product name.

F. Options: Identify options requiring selection by the Architect.

G. Deviations: Identify deviations from the Contract Documents on submittals.

H. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.

I. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will **discard submittals** received from sources other than Contractor.

1. Transmittal Form: Use **AIA Document G810**
2. Transmittal Form: Provide locations on form for the following information:

a. Project name.
b. Date.
c. Destination (To:).
d. Source (From:).
e. Names of subcontractor, manufacturer, and supplier.
f. Category and type of submittal.
g. Submittal purpose and description.
h. Specification Section number and title.
i. Indication of full or partial submittal.
j. Drawing number and detail references, as appropriate.
k. Transmittal number, **numbered consecutively**.
l. Submittal and transmittal distribution record.
m. Remarks.
n. Signature of transmitter.

3. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

J. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

K. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

L. Use for Construction: Use only final submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals via email as a single PDF electronic file per submittal.

    a. Architect will return annotated file or provide a separate comment response form. Annotate and retain one copy of file as an electronic Project record document file.

2. Submit all items required for each Specification Section in **one single submittal**. **Architect will reject and not review submittals that are not complete, including all requirements of the Section into one single submittal,** unless approved in writing by the Architect prior to submitting any portion of the submittal for a given Section.

3. Action Submittals: Submit **three** paper copies of each submittal, unless otherwise indicated. Architect will return **two** copies.
4. Informational Submittals: Submit **two** paper copies of each submittal, unless otherwise indicated. Architect will not return copies.
5. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
6. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

    a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
    b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

7. Test and Inspection Reports Submittals: Submit where required.

B. Product Data: Collect all information from the same Section into a single submittal.

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable, and additional information where required:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.

g. Notation of coordination requirements.
h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

a. Wiring diagrams showing factory-installed wiring.
b. Printed performance curves.
c. Operational range diagrams.
d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:

a. PDF electronic file.
b. **Three** paper copies of Product Data, unless otherwise indicated. Architect will return **two** copies.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Identification of products.
b. Schedules.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least **8-1/2 by 11 inches.**
3. Submit Shop Drawings in the following format:

a. PDF electronic file.
b. **Three** opaque copies of each submittal. Architect will retain **two** copies; remainder will be returned.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
a. When different Sections include samples of materials installed adjacent to each other or within the same room or space, the Contractor shall submit complete submittals for each Section on the same day, when any of the submittals include a substitute product from what is exactly specified. If submittals include products,

materials, and colors as specified, such coordination (same day submittal) is not required, but is recommended.

1.) Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

2. Identification: Attach label on unexposed side of Samples that includes the following:

   a. Generic description of Sample.
   b. Product name and name of manufacturer.
   c. Sample source.
   d. Number and title of applicable Specification Section.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

   a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

   a. Number of Samples: Submit **one** full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

   a. Number of Samples: Submit **three** sets of Samples. Architect will retain **two** Sample sets; remainder will be returned.

      1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
      2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least **three** sets of paired units that show approximate limits of variations.

E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product, matching that identified in the contract documents when noted.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.
5. Submit product schedule in the following format:

    a. PDF electronic file.
    b. **Three** paper copies of product schedule or list, unless otherwise indicated. Architect will return **two** copies.

F. Contractor's Construction Schedule: Comply with requirements specified below.
1. Time Frame: Extend schedule from date established for commencement of the Work to date of final completion.
    a. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
2. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with and include the following.
    a. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
    b. Include Startup and Testing Time
    c. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
    d. Punch List and Final Completion: Include not more than **14** days for punch list and final completion.
3. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
    a. Phasing: Arrange list of activities on schedule by phase.
    b. Work under More Than One Contract: Include a separate activity for each contract.
    c. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
    d. Work Restrictions: Show the effect of the following items on the schedule:
        1) Revise list below to suit Project.
        2) Coordination with existing construction.
        3) Limitations of continued occupancies.
        4) Uninterruptible services.
        5) Partial occupancy before Substantial Completion.
        6) Use of premises restrictions.
        7) Provisions for future construction.
        8) Seasonal variations.
        9) Environmental control.

e. Work Stages: Indicate important stages of construction for each major portion of the Work.

4. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
5. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
   a. Unresolved issues.
   b. Unanswered RFIs.
   c. Rejected or unreturned submittals.
   d. Notations on returned submittals.

~~G.~~ Application for Payment: Comply with requirements specified below.

1. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
   a. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
2. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
3. Payment Application Times: Progress payments shall be submitted to Architect by the 15 of the month. The period covered by each Application for Payment is one month, ending on the **last day of the month**
4. Application for Payment Forms: Use **AIA Document G702 and AIA Document G703**
5. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. **Architect** will return incomplete applications without action.
   a. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
   b. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
6. Transmittal: Submit **three** signed and notarized original copies of each Application for Payment to **Architect** by a method ensuring receipt **within 24 hours**. One copy shall include waivers of lien and similar attachments if required.
   a. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
7. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

   a. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
   b. When an application shows completion of an item, submit conditional final or full waivers.
   c. Owner reserves the right to designate which entities involved in the Work must submit waivers.
   d. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

8. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

    a. List of subcontractors.
    b. Schedule of values.
    c. Contractor's construction schedule (preliminary if not final).
    d. Schedule of unit prices.
    e. Submittal schedule (preliminary if not final).
    f. List of Contractor's staff assignments.
    g. List of Contractor's principal consultants.
    h. Copies of building permits.
    i. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
    j. Initial progress report.
    k. Report of preconstruction conference.
    l. Certificates of insurance and insurance policies.
9. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
    a. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
    b. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
10. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
    a. Evidence of completion of Project closeout requirements.
    b. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
    c. Updated final statement, accounting for final changes to the Contract Sum.
    d. AIA Document G706-1994, "Contractor's Affidavit of Payment of Debts and Claims."
    e. AIA Document G706A-1994, "Contractor's Affidavit of Release of Liens."
    f. AIA Document G707-1994, "Consent of Surety to Final Payment."
    g. Evidence that claims have been settled.
    h. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
    i. Final liquidated damages settlement statement.

H. Schedule of Values: Comply with requirements specified below.
1. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule. **Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.**
    a. Correlate line items in the schedule of values with other required administrative forms and schedules, including the following:
        1) Application for Payment forms with continuation sheets.
        2) Submittal schedule.

3) Items required to be indicated as separate activities in Contractor's construction schedule.

b. Submit the schedule of values to Architect at earliest possible date but no later than 7 days before the date scheduled for submittal of initial Applications for Payment.

c. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.

2. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

a. Identification: Include the following Project identification on the schedule of values:

1) Project name and location
2) Name of Architect
3) Architect's project number
4) Contractor's name and address
5) Date of submittal

b. Arrange schedule of values consistent with format of AIA Document G703.

c. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of 5 percent of Contract Sum.

d. Round amounts to nearest whole dollar; total shall equal the Contract Sum.

e. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

f. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

g. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.

h. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

1) Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

i. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. **Use CSI Form 1.5A.** Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.
4. Submit subcontract list in the following format:

    a. PDF electronic file.
    b. Number of Copies: **Three** paper copies of subcontractor list, unless otherwise indicated. Architect will return **two** copies.

J. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

L. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.

M. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

N. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

O. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

P. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

Q. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

R. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

S. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.

2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

T. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."

U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

W. Field Test Reports: Submit reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

X. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

Y. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit **digitally-signed PDF electronic file and three** paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 01 Section "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S ACTION

A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate **action.**

C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

E. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

F. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 013300

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SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes the following:

1. Administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Contracting Officer or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections:

1. Division 01 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
2. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Contracting Officer.

C. Mockups: Full size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

D. Preconstruction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Contracting Officer for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as

appropriate, for the context of requirements. Refer uncertainties to Contracting Officer for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Contractor's Quality-Control Manager Qualifications: For supervisory personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems.

1. Seismic-force resisting system, designated seismic system, or component listed in the designated seismic system quality assurance plan prepared by the Architect.
2. Main wind-force resisting system or a wind-resisting component listed in the wind-force-resisting system quality assurance plan prepared by the Architect.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Contracting Officer. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: Include in quality-control plan a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Contracting Officer has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.7 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.8 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing

engineering services of the kind indicated. Engineering services are defined as those performed for installations of the systems, assemblies, or products that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Provide sizes and configurations of test assemblies and mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
e. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project, unless indicated otherwise.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Contracting Officer, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as agreed upon by the Contracting Officer and Contractor a minimum of 2 weeks prior to execution. See individual sections for mock-ups required.
2. Notify Contracting Officer seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at the Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Contracting Officer's approval of mockups before starting work, fabrication, or construction.

    a. Allow seven days for initial review and each re-review of each mockup.

6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed, unless otherwise indicated.

1.9 QUALITY CONTROL

A. Contractor Responsibilities: Unless specifically listed otherwise, all tests and inspections are Contractor's responsibility. Perform quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Notify commissioning agent at least 24 hours in advance of time when Work that requires commissioning activities will be performed.
5. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
6. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
7. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Owner Responsibilities: The Owner will engage a qualified testing agency to perform quality control services as indicated below.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Payment for these services will be by the Owner.

3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
4. The Owner's Testing Agency will observe and/or perform the following testing:
   a. Code Required testing and as noted elsewhere in the contract documents.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of the Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Contracting Officer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.10 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Engage a qualified testing agency and/or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Contractor, as included in the "Statement of Structural Special Inspections and Testing" on the Drawings, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Contractor with copy to Contracting Officer and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.
7. Contractor to coordinate and cooperate with Owner's testing agency.

PART 2 - PRODUCTS

2.1 Air Leakage Testing

1. Comply with 2017 City of Boulder Energy Conservation Code.

2. The completed building shall be tested and the air leakage rate of the building envelope shall not exceed 0.40 cfm/ ft2 at a pressure differential of 0.3 inches water gauge (2.0 L/s × m2 at 75 Pa) in accordance with ASTM E779 or an equivalent method approved by the code official.

3. Testing and inspection shall be conducted by a third-party registered design professional. A written report of the test results shall be signed by the party conducting the test and provided to the code official. Testing shall be performed at any time after completion of all penetrations of the building thermal envelope.

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Contracting Officer.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Contracting Officer's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, **Owner's construction forces,** Architect, **occupants of Project,** testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water service use charges for water used by all entities for construction operations.

D. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

E. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

F. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

G. Sewer, Water, and Electric Power Service: Use charges are specified in Division 01 Section "Multiple Contract Summary."

1.2 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

C. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage, including delivery, handling, and storage provisions for materials subject to water absorption or water damage, discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged Work.

1. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

D. Dust-Control and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust-control and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:

1. Locations of dust-control partitions at each phase of the work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air filtration system discharge.
4. Other dust-control measures.
5. Waste management plan.

1.3 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in **the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines** and **ICC/ANSI A117.1**.

1.4 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch- OD corner and pull posts **with 1-5/8-inch- OD top rails.**

B. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10 mils minimum thickness, with flame-spread rating of 15 or less per ASTM E 84.

C. Dust Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches

D. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES – NOT REQUIRED

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of [**10**] <**Insert number**> individuals. Provide electrical power service and 120-V ac duplex receptacles, with not less than 1 receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.
3. Drinking water and private toilet.
4. Coffee machine and supplies.
5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F
6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of **8** at each return air grille in system and remove at end of construction **and clean HVAC system as required in Division 01 Section "Closeout Procedures."**

C. Air Filtration Units: HEPA primary and secondary filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Division 01 Section "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to **municipal system** as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1. Toilets: Use of Owner's existing toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

F. Heating **and Cooling**: Provide temporary heating **and cooling** required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

G. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Prior to commencing work, isolate the HVAC system in area where work is to be performed in accordance with approved coordination drawings.

    a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
    b. Maintain negative air pressure within work area using HEPA-equipped air filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.

2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust containment devices.
3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

H. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.

I. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.

J. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service **overhead** or **underground**, unless otherwise indicated.
2. Connect temporary service to Owner's existing power source, as directed by Owner.

K. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
2. Install lighting for Project identification sign.

L. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install **one** telephone line(s) for each field office.

1. Provide additional telephone lines for the following:

    a. Provide a dedicated telephone line for each facsimile machine in each field office.

2. At each telephone, post a list of important telephone numbers.

    a. Police and fire departments.
    b. Ambulance service.
    c. Contractor's home office.
    d. Architect's office.
    e. Engineers' offices.
    f. Owner's office.
    g. Principal subcontractors' field and home offices.

3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

M. Electronic Communication Service: Provide a computer in the primary field office adequate for use by Architect and Owner to access project electronic documents and maintain electronic communications.

1. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these 3 functions.
2. Internet Service
3. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing and spam protection in a combined application.
4. Backup: External hard drive, minimum **40** gigabyte, with automated backup software providing daily backups.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas **within construction limits indicated** on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 31 Section "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 32 Section "Asphalt Paving."

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Parking: **Use designated areas of Owner's existing** parking areas for construction personnel.

F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

    a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touchup signs so they are legible at all times.

H. Waste Disposal Facilities: Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."

I. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.

J. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

K. Temporary Elevator Use: **Use of elevators is not permitted**

L. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.

1. Do not load elevators beyond their rated weight capacity.
2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.

M. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

N. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

O. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Division 01 Section "Summary."

B. Temporary Erosion and Sedimentation Control: Comply with **requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and** requirements in specifications.

C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to **requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent**.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from the project site during the course of the project.
4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Tree and Plant Protection: Comply with requirements specified in Division 01 Section "Temporary Tree and Plant Protection."

F. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

G. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.

H. Site Enclosure Fence: **Before construction operations begin**, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: **As required to enclose entire Project site or portion determined sufficient to accommodate construction operations**
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. **Furnish one set of keys to Owner.**

I. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

J. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

K. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

L. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction **and requirements indicated on Drawings**.

1. Construct covered walkways using scaffold or shoring framing.
2. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.

3. Paint and maintain appearance of walkway for duration of the Work.

M. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

N. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by **Owner** from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.
2. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant treated plywood.

    a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.

3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
4. Insulate partitions to control noise transmission to occupied areas.
5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
6. Protect air-handling equipment.
7. Provide walk-off mats at each entrance through temporary partition.

O. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard, replace or clean stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use permanent HVAC system to control humidity.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for **24** hours are considered defective.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record daily readings over a forty-eight hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    c. Remove materials that can not be completely restored to their manufactured moisture level within **48** hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.

D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

E. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within **15** days of receipt of request, or **seven** days of receipt of additional information or documentation, whichever is later.

    a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
    b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.

2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. Refer to Divisions 02 through 49. Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:

    a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements.
    b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

4. Manufacturers:

    a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
    b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Division 01 Section "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE / "OR-EQUAL" PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.
6. No additional cost associated with the selection of the proposed product, meeting all specified requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

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SECTION 017329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least **10** days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
3. Products: List products to be used and firms or entities that will perform the Work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.
6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. **Architect's** Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. **Operating elements include the following:**

1. Primary operational systems and equipment.
2. Air or smoke barriers.
3. Fire-suppression systems.
4. Mechanical systems piping and ducts.
5. Control systems.
6. Communication systems.
7. Conveying systems.
8. Electrical wiring systems.
9. Operating systems of special construction in Division 13 Sections.

C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. **Miscellaneous elements include the following:**

1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Exterior curtain-wall construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.
6. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

1. Include Manufacturer's Field Representative onsite during cutting and patching activities if warranty questions arise or as required to maintain warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to **minimize** interruption to occupied areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. **Concrete**, **Masonry**: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 017329

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit Project Record Documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.

12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. **Submit demonstration and training video recordings.**

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. **Use CSI Form 14.1A.**

1. Organize list of spaces in sequential order.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Architect
    d. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:

    a. PDF electronic file.
    b. **Three** paper copies of product schedule or list, unless otherwise indicated. Architect will return **two** copies.

1.6 WARRANTIES

A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Partial Occupancy: Submit properly executed warranties within **15** days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that meet Green Seal GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.

j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.
l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

    1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.

m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
q. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter upon inspection.

    1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report upon completion of cleaning.

r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
s. Leave Project clean and ready for occupancy.

C. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Prepare a report.

D. Construction Waste Disposal: Comply with all Federal, State and local waste disposal requirements and any additional requirements indicated in the contract documents.

END OF SECTION 017700

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SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Maintenance manuals for the care and maintenance of **systems and equipment**.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

A. Initial Submittal: Submit **2** draft copies of each manual at least **15** days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return **one copy** of draft and mark whether general scope and content of manual are acceptable.

B. Final Submittal: Submit **one copy** of each manual in final form at least **15** days before final inspection. Architect will return copy with comments within **15** days after final inspection.

1. Correct or modify each manual to comply with Architect's comments. Submit **3** copies of each corrected manual within **15** days of receipt of Architect's comments.

1.5 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:

1. List of documents.
2. List of systems.
3. List of equipment.
4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name, address, and telephone number of Contractor.
6. Name and address of Architect.
7. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

E. **Electronic Deliverable**: In addition to hardcopy/bound manuals, submit all final manuals in electronic format on a CD.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.

2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions.
2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.

5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.

5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard printed maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training videotape, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and

flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

1. Do not use original Project Record Documents as part of operation and maintenance manuals.

G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 220000 - BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including the, General and Supplementary Conditions, Division-1 Conditions specification sections apply to the Division 22 specifications and drawings.

B. Related Sections: Refer to all sections in Division 22 and Division 22 drawings. Refer to Division 26 specification section and Division 26 drawings.

1.2 SUMMARY

A. This Section specifies the basic requirements for plumbing installations and includes requirements common to more than one (1) section of Division 22. It expands and supplements the requirements specified in sections of Division 1 and Division 22.

B. The Contractor shall coordinate and co-operate with Owner at all times for all new to existing connections, system shutdowns and restart-up, flushing and filling both new and existing systems.

C. Provide temporary piping services where required to maintain existing areas operable, as shown on the drawings.

D. Coordinate all services shutdown with the Owner, provide temporary services as shown on the drawings.

E. The Contractor shall be responsible for the maintenance operation and servicing of all new plumbing systems which are to be used by the Owner during the time of any occupancy and use of any areas within the construction limitations before final completion or acceptance of the systems. A written record of maintenance, operation and servicing shall be turned over to the Owner prior to final acceptance.

1.3 PROJECT CONDITIONS

A. The Contractor shall be required to attend a mandatory pre-bid walk-thru and shall make themselves familiar with the existing conditions. No additional costs to the Owner shall be accepted for additional work for these existing conditions.

B. Field verify all existing conditions prior to submitting bids.

C. Report any existing damaged equipment or systems to the Owner prior to any work.

D. Protect all plumbing and electrical work against theft, injury or damage from all causes until it has been tested and accepted.

E. Be responsible for all damage to the property of the Owner or to the work of other contractors during the construction and guarantee period. Repair or replace any part of the Work which may show defect during one (1) year from the final acceptance of all work. Provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not due to the Owner's carelessness or improper use.

1.4 INSTALLER'S QUALIFICATIONS

A. All Plumbing Work shall be performed by a State of Colorado Licensed Contractor under the supervision of a Licensed Plumber. The General Contractor shall verify that plumbers are currently licensed by the State of Colorado and shall supply the General Contractor Project Manager with names and license numbers. Plumbing Contractors shall have a minimum of three (3) years of satisfactory performance in conducting the type of work specified.

1.5 ACCESSIBILITY

A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

B. Furnish hinged steel access doors with concealed latch, whether shown on drawings or not, in all walls and ceilings for access to all concealed valves, shock absorbers, air vents, motors, balancing cocks, and other operating devices requiring adjustment or servicing. Refer to Division 1 for access door specification.

C. The minimum size of any access door shall not be less than the size of the equipment to be removed or 24-inch x 24-inch if used for service only, unless size is indicated on Drawings.

D. Furnish doors to trades performing work in which they are to be built, in ample time for building-in as the work progresses. Whenever possible, group valves, cocks, etc., to permit use of minimum number of access doors within a given room or space.

E. Factory manufactured doors shall be of a type compatible with the finish in which they are to be installed.

F. Access doors in fire-rated walls and ceilings shall have equivalent UL label and fire rating.

1.6 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough-in requirements.

1.7 REQUIREMENTS OF REGULATORY AGENCIES

A. Refer to Division 1.

B. Execute and inspect all work in accordance with all Underwriters, local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the greater requirement shall be followed. Follow recommendations of NFPA, EPA, OSHA and ASHRAE.

C. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.

D. The handling, removal and disposal of regulated refrigerants shall be in accordance with U.S. EPA, state and local regulations.

E. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

1.8 REQUIREMENTS OF LOCAL UTILITY COMPANIES

A. Comply with rules and regulations of local utility companies. Include in bid the cost of all valves, valve boxes, meter boxes, meters and such accessory equipment which will be required for the project.

1.9 PERMITS AND FEES

A. Refer to Division 1.

B. Owner shall pay all tap, development, meter, etc., fees required for connection to municipal and public utility facilities.

C. Contractor shall arrange for and pay for all permits, inspections, licenses and certificates required in connection with the Work.

1.10 PLUMBING INSTALLATIONS

A. Drawings are diagrammatic in character and do not necessarily indicate every required offset, valve, fitting, etc.

B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both.

C. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, take the necessary measurements and prepare the drawings.

D. Before any Work is installed, determine that equipment will properly fit the space; that required piping grades can be maintained and that ductwork can be run as contemplated without interferences between systems, with structural elements or with the work of other trades.

E. Coordinate the installation of mechanical materials and equipment above and below ceilings with suspension system, light fixtures, and other building components.

1. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electric systems within the cavity space allocation in the following order of priority.

a. Plumbing waste, vent piping and roof drain mains and leaders
b. Supply, return and exhaust ductwork
c. Fire sprinkler mains and leaders
d. Electrical conduit
e. Domestic hot and cold water, medical gas piping
f. Pneumatic control piping
g. Fire sprinkler branch piping and sprinkler runouts

F. Verify all dimensions by field measurements.

G. Arrange for chases, slots, and openings in other building components to allow for plumbing installations.

H. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

I. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

J. Coordinate the cutting and patching of building components to accommodate the installation of plumbing equipment and materials.

K. Where mounting heights are not detailed or dimensioned, install plumbing piping and overhead equipment to provide the maximum headroom possible.

L. Install plumbing equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

M. Coordinate connection of plumbing systems with exterior underground and overhead utilities, services and Division 33. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

1.11 EXCAVATING AND BACKFILLING

A. General:

1. Provide all necessary excavation and backfill for installation of Plumbing Work in accordance with Division 1.
2. In general, follow all regulations of OSHA as specified in Part 1926, Subpart P, "Excavations, Trenching and Shoring". Follow specifications of Division 22 as they refer specifically to the Plumbing Work.

B. Contact Owners of all underground utilities to have them located and marked, at least two (2) business days before excavation is to begin. Also, prior to starting excavation, brief employees on marking and color codes and train employees on excavation and safety procedures for natural gas lines. When excavation approaches gas lines, expose lines by carefully probing and hand digging.

C. Provide all necessary pumping, cribbing and shoring.

D. Walls of all trenches shall be a minimum of 6-inch clearance from the side of the nearest mechanical work. Install pipes with a minimum of 6-inch clearance between them when located in same trench.

E. Pipe Trenching:

1. Dig trenches to depth, width, configuration, and grade appropriate to the piping being installed. Dig trenches to 6-inches below the level of the bottom of the pipe to be installed. Install 6-inch bed of pea gravel or squeegee, mechanically tamp to provide a firm bed for piping, true to line and grade without irregularity. Provide depressions only at hubs, couplings, flanges, or other normal pipe protrusions.

F. Backfilling shall not be started until all work has been inspected, tested and accepted. All backfill material shall be reviewed by the Soils Engineer. In no case shall lumber, metal or other debris be buried in with backfill.

G. Trench Backfill:

1. Backfill to 12-inches above top of piping with pea gravel or squeegee, the same as used for piping bed, compact properly.
2. Continue backfill to finish grade, using friable material free of rock and other debris. Install in 6-inch layers, each properly moistened and mechanically compacted prior to installation of ensuing layer. Compaction by hydraulic jetting is <u>not</u> permissible.

H. After backfilling and compacting, any settling shall be refilled, tamped, and refinished at this Contractor's expense.

I. This Contractor shall repair and pay for any damage to finished surfaces.

J. Complete the backfilling near manholes using pea gravel or squeegee, installing it in 6-inch lifts and mechanically tamping to achieve 95 percent compaction.

K. Use suitable excavated material to complete the backfill, installed in 6-inch lifts and mechanically compacted to seal against water infiltration. Compact to 95 percent for the upper 30-inches below paving and slabs and 90 percent elsewhere.

1.12 CUTTING AND PATCHING

A. This Article specifies the cutting and patching of mechanical equipment, components, and materials to include removal and legal disposal of selected materials, components, and equipment.

B. Refer to Division 1.

C. Do not endanger or damage installed work through procedures and processes of cutting and patching.

D. Arrange for repairs required to restore other work, because of damage caused as a result of plumbing installations.

E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.

F. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover work to provide for installation of ill-timed work;
2. Remove and replace defective work;
3. Remove and replace work not conforming to requirements of the Contract Documents;
4. Remove samples of installed work as specified for testing;
5. Install equipment and materials in existing structures;
6. Upon written instructions from the Architect, uncover and restore work to provide for Architect observation of concealed work.

G. Cut, remove and legally dispose of selected plumbing equipment, components, and materials as indicated, including, but not limited to removal of plumbing piping, plumbing fixtures and trim, and other plumbing items made obsolete by the new work.

H. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

I. Provide and maintain an approved type of temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

J. Locate, identify, and protect mechanical, plumbing and electrical services passing through remodeling or demolition area and serving other areas required to be maintained operational. **When services must be interrupted, provide temporary services for the affected areas and notify the Owner prior to changeover.**

1.13 TEMPORARY FACILITIES

A. New Plumbing Fixtures shall not be used without written permission from the owner.

1.14 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to the Instructions to Bidders and Division 1, "PRODUCTS, OPTIONS AND SUBSTITUTION".

1.15 PLUMBING SUBMITTALS

A. Refer to the Conditions of the Contract (General and Supplementary), Division 1 and AIA Document A201 (1987) Edition, "SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES".

B. The manufacturer's material or equipment listed in the schedule or identified by name on the drawings are the types to be provided for the establishment of size, capacity, grade and quality. If alternates are used in lieu of the scheduled names, the cost of any changes in construction required by their use shall be borne by Contractor.

C. All equipment shall conform to the State and/or Local Energy Conservation Standards.

D. Submittal of shop drawings, product data, and samples will be accepted only when submitted by and stamped by the Contractor. Data submitted from subcontractors and material suppliers directly to the Architect will not be processed unless prior written approval is obtained by the Contractor.

E. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.

F. If more than two (2) submittals (either for shop drawings or for as-built drawings) are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.

G. Before starting Work, prepare and submit to the Architect all shop drawings and descriptive equipment data required for the project. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned without action or "Revise and Resubmit". Continue to submit shop drawings after each Engineer's action, until a "Reviewed" action is received. The Contractor shall submit the total number of sets as called for in Division 1 to the Architect for final distribution. Submittals shall include the following specified materials and, in addition, any materials not listed below but which are specified in the individual sections of Division 22 which follow.

1. Pipe Markers
2. Sanitary and storm drainage piping, fittings and joining materials
3. Water treatment equipment, including water softeners
4. Plumbing fixtures, trim, fittings and rough-in dimensions, cleanouts and drains
5. Domestic water piping, fittings and joining materials
6. Domestic water heaters and domestic hot water generators

7. Water hammer arresters
8. Valves, including pressure relief and pressure regulating
9. Pumps
10. Thermometers and pressure gauges
11. Supports, anchors and seals
12. Flexible pipe connectors
13. Vibration isolators
14. Insulation, including plastic pipe fitting insulation covers and manufacturer's installation instructions
15. Automatic control systems

H. Wiring diagrams, control panelboards, motor test data, motors, starters and controls for electrically operated equipment furnished by plumbing trades.

I. Identify each item with equipment tag with specification section and sufficient data to certify its compliance with the specifications.

J. Electronic submittals shall be packaged as a bookmarked multi-page single PDF file and shall not be over 5MB. Electronic Submittals over 5MB will not be accepted and will be returned un-reviewed.

1.16 REQUESTS FOR INFORMATION

A. All "Requests for Information" submitted by the Contractor shall include a proposed solution and an estimated cost/schedule impact. Any RFI's that do not contain this required information will be sent back to the Contractor unanswered.

1.17 PLUMBING COORDINATION DRAWINGS

A. Prepare and submit a complete set of 3-D Coordination Drawings as necessary or required by the Engineer showing major elements, components, and systems of plumbing equipment and materials in relationship with other trades, sub-trades and building components. Prepare drawings to an accurate scale of 1/4"=1'-0" or larger. Indicate the locations of all equipment and materials, including clearances for installing and maintaining insulation, servicing and maintaining equipment, valve stem movement, and similar requirements. Indicate movement and positioning of large equipment into the building during construction.

B. This project has been completed in Revit. This Contractor shall review the model created by the Architect/Engineer that illustrated the design intent of the project. This model is not intended to be used as a shop drawing, but as a tool to enable the Contractor to fabricate and coordinate the installation of the work described in these documents.

C. Prepare and submit a complete set of 3-D Coordination/Fabrication Drawings showing major elements, components, and systems of mechanical equipment and materials in relationship with other trades, sub-trades and building components. Prepare 3D drawings to an accurate scale of 1/4"=1'-0" or larger when plotted. Indicate the locations of all equipment and materials, including clearances for installing and maintaining insulation, servicing and maintaining equipment, valve stem movement, and similar requirements.

Indicate movement and positioning of large equipment into the building during construction.

D. Review in detail all floor plans, reflected ceiling plans, elevations, sections, and details to conclusively coordinate with all trades and integrate all installations. Indicate locations where space is limited, and where sequencing and coordination of installations are of importance to the efficient flow of the work, including (but not necessarily limited to) the following:

1. Mechanical equipment room layouts;
2. Specific equipment installations, including:
   a. Cooling Towers;
   b. Air Handling Units;
   c. Sewage Ejector Systems;
   d. Sump Pump Systems;

3. Work in pipe spaces, chases, trenches, and tunnels;
4. Exterior wall penetrations;
5. Ceiling plenums which contain piping, ductwork, or equipment in congested arrangement;
6. Installations in mechanical riser shafts, at typical sections and crucial offsets and junctures;
7. Numbered valve location diagrams;
8. Exterior underground lines in common excavation;
9. Roof penetrations.
10. Elevations and locations of Division 33 connections.

1.18 PRODUCT LISTING

A. Prepare listing of major plumbing equipment and materials for the project, within two (2) weeks of signing the Contract Documents and transmit to the Mechanical Engineer.

B. Unless otherwise specified, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.

C. Provide all information requested.

D. Submit this listing as a part of the submittal requirement specified in Division 1, "PRODUCTS AND SUBSTITUTION".

E. When two (2) or more items of same material or equipment are required (plumbing fixtures, valves, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in work, except as otherwise indicated.

F. Provide products which are compatible within systems and other connected items.

1.19 NAMEPLATE DATA

A. Provide permanent operational data nameplate on each item of plumbing equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

1.20 DELIVERY, STORAGE, AND HANDLING

A. Refer to Division 1.

B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

C. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage, dirt, dust and moisture.

D. Coordinate deliveries of plumbing materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

E. Provide factory-applied plastic end-caps on each length of pipe and tube, except for hub-and-spigot and no-hub pipe. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

F. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.

G. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.21 RECORD DOCUMENTS

A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.

B. Keep a complete set of record document prints or electrical mark-ups in custody during entire period of construction at the construction site.

C. Mark drawing prints to indicate revisions to piping, size and location both exterior and interior; including locations of control devices and units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; 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., strainers, expansion compensators, tanks, etc.); RFI's; change orders; concealed control system devices. Changes to be noted on the drawings shall include final location of any piping relocated more than 1'-0" from where shown on the drawings.

D. Mark Equipment Schedules on the drawings with changes to Manufacturer, Model Number, and data based on reviewed shop drawings.

E. At the completion of the project, mark all valve tag numbers on the drawings and turn these drawings over to the General Contractor for his submission to the Architect. This Contract will not be considered completed until these record drawings have been received and reviewed by the Architect.

1.22 OPERATION AND MAINTENANCE DATA

A. Refer to Division 1.

B. In addition to the information required by Division 1 for maintenance data, include the following information:

1. Description of plumbing equipment, function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.
5. Manufacturer's service manuals for all plumbing equipment provided under this Contract.
6. Include the valve tag list.
7. Name, Address and Telephone Number of party to be contacted for twenty-four (24) hour service for each item of equipment.
8. Starting, stopping, lubrication, equipment identification numbers and adjustment clearly indicated for each piece of equipment.
9. Complete parts list.
10. Plumbing warranties.

C. This Contract will not be considered completed, nor will final payment be made, until all specified material is received in this Operating and Maintenance Report and the manual is reviewed by the Architect.

1.23 LUBRICATION OF EQUIPMENT

A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.

B. Contractor shall properly lubricate all plumbing pieces of equipment which he provided before turning the building over to the Owner. He shall attach a linen tag or heavy duty shipping tag on the piece of equipment showing the date of lubrication and the type and brand of lubricant used.

C. Furnish the Engineer with a Electronic Document, of each item lubricated and type of lubricant used, no later than two (2) weeks before completion of the project, or at time of acceptance by the Owner of a portion of the building and the mechanical systems involved.

1.24 DEMOLITION

A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.

B. During the demolition phase of this Contract, it is the responsibility of this Contractor to carefully remove existing equipment, piping, fixtures and related items either as shown on the demolition drawings as being removed, or as required for the work. These items shall be tagged, protected from damage, and stored as directed by the Architect. A list of all items stored shall be turned over to the Architect. At the completion of the remodeling work or when directed by the Architect, all stored items not reused or wanted by the Owner shall be removed from the premises. Disposition of items not reused is by the direction of the Architect.

1. Return existing plumbing fixtures to the Owner.

C. The location of existing equipment, pipes, etc., shown on the drawings has been taken from existing drawings and is, therefore, only as accurate as that information. All existing conditions shall be verified from field measurements with necessary adjustment being made to the drawing information.

D. If asbestos material, in any form, is discovered by this Contractor in the process of his work, he shall report such occurrence to the Architect immediately. The Architect will determine the action to be taken for the asbestos removal, which is not a part of the work to be done under this Division.

1.25 WARRANTIES

A. Refer to Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. In any case, the entire mechanical system shall be warranted no less than one (1) year from the time of acceptance by the Owner.

B. Compile and assemble the warranties specified in Division 22, into a separated set of vinyl covered, three-ring binders, tabulated and indexed for easy reference.

C. Provide complete warranty information for each item to include product or equipment to include date or beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.26 CLEANING

A. Refer to Division 1.

B. Refer to other sections of Division 22, for requirements cleaning strainers and disinfection of plumbing systems prior to final acceptance.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION – 220000

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of Piping Specialties Work required by this section is indicated on drawings and schedules and by requirements of this section.

B. Types of Piping Specialties specified in this section include the following:

1. Escutcheons
2. Dielectric Fittings
3. Mechanical Sleeve Seal
4. Fire and Smoke Barrier Penetration Seal
5. Pipe Sleeve
6. Sleeve Seals

C. Piping Specialties furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 22 sections.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of piping specialties of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. ASME B 31.9 "Building Services Piping" for materials, products, and installation.
2. Safety valves and pressure vessels shall bear the appropriate ASME label.
3. Fabricate and stamp air separators and compression tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
4. ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualification" for qualifications for welding processes and operators.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions, and dimensioned drawings for each type of manufactured piping specialty. Include pressure drop curve or chart for each type and size of pipeline strainer. Submit schedule showing manufacturer's figure number, size, location, and features for each required piping specialty.

B. Shop Drawings: Submit for fabricated specialties, indicating details of fabrication, materials, and method of support.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of manufactured piping specialty. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Pipe Escutcheons:

   a. Chicago Specialty Mfg. Co.
   b. Producers Specialty & Mfg. Corp.
   c. Sanitary-Dash Mfg. Co.

2. Dielectric Fittings:

   a. B & K Industries, Inc.
   b. Capital Mfg. Co.; Division of Harsco Corp.
   c. Eclipse, Inc.
   d. Epco Sales, Inc.
   e. Perfection Corp.
   f. Rockford-Eclipse Division

3. Mechanical Sleeve Seal:

   a. Thunderline Corp.
   b. "Metraseal" by Metraflex Co.

4. Fire and Smoke Barrier Penetration Seal:

   a. Electrical Products Division/3M
   b. Dow Corning
   c. Flame Stop, Inc.
   d. MetaCaulk
   e. Hilti
   f. HoldRite

2.2 PIPE ESCUTCHEONS

A. General: Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.

C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.

2.3 DIELECTRIC FITTINGS

A. General: Provide standard products recommended by manufacturer for use in service indicated, which effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion.

B. Dielectric Unions: Provide dielectric unions on open systems where indicated on the Drawings. **Not to be used in Closed Heating Systems.**

C. Dielectric Waterway Fittings:

1. ASTM-A53 Xinc electroplated steel pipe casing with inert, non-corrosive thermoplastic lining (NSF/FDA listed).
2. Thread x thread ends 1/2-inch x 3-inch through 4-inch x 6-inch.
3. Groove x thread ends 1/2-inch x 4-inch through 4-inch x 6-inch.
4. Listed by IAPMO/UPC and SBCC PST and ESI.
5. Dielectric unions are not an acceptable substitute for dielectric waterway fittings.

D. Dielectric Flange Insulation Kits:

1. Field-assembled, companion flange assembly, full face or ring type.
2. Neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
3. Provide separate companion flanges and steel bolts and nuts.
4. Rated at 175 psi conforming to ANSI B16.42 (iron) B16.24 (bronze).
5. Factory certified to withstand minimum of 600 volts on a dry line without flashover.
6. Meets federal specifications for tensile strength and thread end connections.

2.4 MECHANICAL SLEEVE SEALS

A. General: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.5 FIRE AND SMOKE BARRIER PENETRATION SEALS

A. General: Provide UL Listed firestopping systems composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

B. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

C. Penetrations in Fire Resistive Rated Walls: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

1. F-Rating: Not less than the fire-resistance rating of the wall construction being penetrated.

D. Penetration in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

1. F-Rating: Minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
2. T-Rating: When penetrant is located outside of a wall cavity, minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
3. W-Rating: Class 1 rating in accordance with water leakage test per UL 1479.

E. Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with UL1479 or ASTM E 814.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at both ambient and elevated temperatures.

2.6 FABRICATED PIPING SPECIALTIES

A. Pipe Sleeves: Provide pipe sleeves of one (1) of the following:

1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges: 3-inch and smaller, 20 gauge; 4-inch to 6-inch, 16 gauge; over 6-inch, 14 gauge.
2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
3. Iron Pipe: Fabricate from cast iron or ductile iron pipe; remove burrs.

B. Sleeve Seals: Provide sleeve seals for sleeves located in foundation walls below grade, or in exterior walls, of one (1) of the following:

1. Mechanical Sleeve Seals: Installed between sleeve and pipe.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration through floors, walls, partitions, and ceilings where penetration is exposed to view; and on exterior of

building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surface.

B. Dielectric Unions: Install at each piping joint between ferrous and non-ferrous piping. Comply with manufacturer's installation instructions.

C. Mechanical Sleeve Seals: Loosely assemble rubber links around pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.

D. Fire or Fire/Smoke Barrier Penetration Seals: Where pipe penetration occurs in fire or fire/smoke rated walls, provide~~:~~ a complete listed protection assembly equal to the rating of the wall/floor.

E. Provide dielectric waterways or insulating flanges, as required by pipe size, on all connections of dissimilar metals.

3.2 SLEEVES AND SEALS

A. Pipes:

1. Pipes:

a. New Construction: Pipes penetrating concrete or masonry construction, whether insulated or not, shall be provided with sheet metal or pipe sleeves fitted into place at time of construction. In poured concrete, the sleeves shall be steel pipe with a full circle, continuously welded water stop plate to also act as a sleeve anchor. When installing Link-Seal the sleeve and Link-Seal shall be of matched sizes. Otherwise, sleeves shall be of such size to provide all around clearance of 1/4-inch to 1-inch. Seal entire space between pipe and sleeve with fire stopping as specified in "Seals".

b. Existing Construction: For existing construction or masonry construction, prepare pipe opening by carefully cutting or core drilling, install sheet metal sleeve, and fill any open space with material assembly equal to the listing of the wall. Cutting of concrete or masonry shall be done after approval of Structural Engineer.

c. Sleeves in non-fire rated or non-bearing walls, floors or ceilings, new or existing construction, shall be steel pipe or galvanized sheet metal with lock-type longitudinal seam. Pack all open spaces on each end with mineral wood or other non-combustible material, positively fastened in place. Asbestos is not acceptable.

d. Where a pipe of any description passes through a concrete floor, the sleeve shall extend at least 2-inch above the finished floor, except when using the ProSet Systems.

e. At Contractor's option, where uninsulated pipes penetrate cast-in-place concrete floors, the "ProSet Systems," Atlanta, Georgia, sleeving may be employed.

f. For pipes penetrating foundation walls, water-proofing membrane floors or other places where water leakage could be encountered, install Link-

Seal wall sleeves by Thunderline Corporation in manner recommended by the manufacturer.

B. Where pipe penetrations occur in non-fire rated floors, roof slabs, or walls, the space between pipe insert and the sleeve shall be packed on each end with mineral wool or other non-combustible material, positively fastened in place. Use plenum rated caulk to seal packing around pipe.

C. Seals:
1. General:

a. Seal all holes or voids where mechanical systems penetrate fire rated floors and walls with a fire stopping sealant having a fire rating equal to or greater than that of the construction being penetrated. The sealant shall meet the requirements of ASTM E-814, ASTM E-119 and UL-1479. It shall be installed with strict adherence to the manufacturer's instructions and according to the product's UL Laboratory listing. The use of asbestos in any form is not permitted.

2. Conduct tests according to manufacturer's written recommendations to verify that substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt and other foreign substances capable of impairing bond of firestoping.
3. Do not cover firestopping with other construction until approval of authority having jurisdiction has been received.

D. Escutcheons:

1. In finished parts of the building, after painting is completed, install chromium plated escutcheons on all pipes passing through walls and floors where piping is exposed to view.

E. Flash and counterflash where mechanical equipment passes through weather or water-proofed walls, floors, and roofs per roof manufacturer's instructions.

F. Provide dielectric waterways or insulating flanges, as required by pipe size, on all connections of dissimilar metals.

3.3 INSTALLATION OF FABRICATED PIPING SPECIALTIES

A. Pipe Sleeves: Install pipe sleeves of types indicated where piping passes through walls, floors, ceilings, and roofs. Do not install sleeves through structural members of work, except as detailed on drawings, or as reviewed by Architect/Engineer. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insert will have free movement in sleeve, including allowance for thermal expansion; but not less than two (2) pipe sizes larger than piping run. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves. Extend floor sleeves 4-inch above finished floor in all Mechanical Equipment Rooms and pipe chases. Provide temporary support of sleeves during placement of concrete and other work

around sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeves.

1. Install sheet metal sleeves at interior partitions and ceilings other than suspended ceilings.
2. Install iron pipe sleeves at exterior penetrations; both above and below grade.
3. Install steel pipe sleeves except as otherwise indicated.

END OF SECTION 220500

SECTION 220516 - PIPE EXPANSION JOINTS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of Expansion Compensation Products required by this section is indicated on drawings and/or specified in other Division 23 sections.

B. Types of Expansion Compensation Products specified in this section include the following:

1. Packless Expansion Joints:

a. Externally Pressurized Bellows Expansion Joints
b. Bellows Expansion Joints
c. Expansion Compensators
d. Rubber Expansion Joints

2. Pipe Alignment Guides.

C. Expansion Compensation Products furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 23 sections.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of expansion compensation products of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. EJMA Compliance: Construct expansion compensation products in accordance with standards of the Expansion Joint Manufacturer's Association (EJMA).

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of expansion compensation product. Submit expansion compensation schedule showing manufacturer's figure number, size, location, and features for each required expansion compensation product.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of expansion compensation product, indicating dimensions, weights, required clearances, and methods of assembly of components.

C. Shop Drawings: Submit shop drawings for fabricated expansion loops indicating location, dimensions, pipe sizes, and location and method of attachment of anchors.

D. Maintenance Data: Submit maintenance data and spare parts lists for each type of expansion compensation product. Include this data, product data, and shop drawings in Maintenance Manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Packless Expansion Joints Compensators:

   a. Flexonics Division; UOP, Inc.
   b. Hyspan Precision Products, Inc.
   c. Keflex, Inc.
   d. Metraflex Co.
   e. American BOA, Inc.

2. Packless Rubber Expansion Joints:

   a. Garlock; Mechanical Packing Division
   b. Mason Industries, Inc.
   c. Metraflex Co.

3. Pipe Alignment Guides:

   a. Hyspan Precision Products,Inc.
   b. Metraflex Co.
   c. Keyflex, Inc.

4. Slip Joints:

   a. Advanced Thermal Systems, Inc.
   b. Hyspan Precision Products, Inc.

5. Flexible Ball Pipe Joints:

   a. Advanced Thermal Systems, Inc.
   b. Barco Division, Marison Industries
   c. Gustin-Bacon Division; Aeroquip Corp.

6. Grooved Piping Couplings and Nipples Expansion Joints:

   a. Gustin-Bacon Division; Aeroquip Corp.
   b. ITT Grinnell
   c. Victaulic Co. of America

2.2 PIPE EXPANSION JOINTS, GENERAL

A. Pipe expansion joints shall provide 200 percent absorption capacity of calculated piping expansion between anchors.

2.3 PACKLESS EXPANSION JOINTS

A. General: Provide bellows expansion joints where indicated for piping systems, with materials and pressure/temperature ratings selected by manufacturer to suit intended service. Select expansion joints to provide 200 percent absorption capacity with 30 percent safety factor.

B. Bellows-Type Expansion Joints:

1. Externally Pressurized, Bellows-Type:

a. ASTM A240 T304 Stainless Steel laminated bellows.
b. Flanged Connections, conforming to ANSI B16.5.
c. Lifting lug.
d. Drain port.
e. 150 psig design pressure.
f. Minimal warranted cycle life of 10,000 full-stroke cycles.
g. Internally guided.

2. Bellows-Type Expansion Joint:

a. ASTM A240 T304 Stainless Steel laminated bellows.
b. Flanged connections, conforming to ANSI B16.5.
c. 150 psig design pressure.
d. Internal stainless steel liner.
e. Shouldered support of bellows to minimize stress at pipe-bellows weld.
f. External shroud
g. Minimum warranted life of 10,000 full-stroke cycles.

C. Expansion Compensators: Pressure rated for 100 psi for low-pressure systems and for 175 psi for high-pressure systems with a cycle life of 10,000 full-stroke cycles. Units shall have 2-ply phosphor bronze bellows, brass shrouds, and end fittings for copper piping systems and 2-ply stainless steel bellows, carbon steel shrouds, and end fittings for steel piping systems. Expansion compensators shall have internal guides and anti-torque device and removable end clip for proper positioning.
1. Provide Keflex Series 7Q; or Equal.

D. Rubber Expansion Joints: Fabric-reinforced butyl rubber with full-faced integral flanges, external control rods and shall be internally reinforced with steel retaining rings over entire surface of flanges, drilled to match flange bolt holes.

2.4 SLIP JOINTS

A. Slip Joints: Carbon steel slip type, designed for repacking under pressure. Slip joints shall have drip connections for steam piping systems and flanged or weld ends to mate with piping system. Packing shall be an asbestos-free compound.

2.5 FLEXIBLE BALL PIPE JOINTS

A. Joints shall be designed for 360 degree rotation and with minimum of 30 degree angular deflection for sizes 6-inches and smaller; 15 degree for sizes 8-inches and larger.

B. Joints shall be carbon steel and shall comply with Section II of ASME Boiler and Pressure Vessel Code and ASME B31.9 "Building Service Piping" for materials and design of pressure containing parts and bolting. Packing shall be asbestos-free composition.

1. Each assembly shall be factory tested with steam at working pressure of piping system for zero (0) leaks before shipment.

2.6 EXPANSION JOINTS FOR GROOVED PIPING

A. Combination Couplings and Nipples: Cut grooved short ASTM A 53 steel pipe nipples and ductile iron or malleable iron couplings, with removable ties to hold joint compressed or expanded during piping fabrication. Select suitable gasket materials for piping system.

B. Slip-Type Expansion Joints: Ductile iron or malleable iron housing, ASTM A 53 steel pipe body, and polytetrafluoroethylene (PTFE) modified polyphenylene coated steel pipe slide. Select suitable gasket material for piping system.

2.7 PIPE ALIGNMENT GUIDES

A. General: Provide pipe alignment guides at locations and spacing indicated. Construct with 4-finger spider traveling inside guiding sleeve, with provision for anchoring to concrete substrate.

1. Grinnell Fig. 256
2. Metraflex Style IV

a. Guides shall be equipped with factory insulation insert, thickness to match adjoining insulation. Insulation shall be Hydrous Calcium Silicate, 1200 degree F maximum temperature, with 0.31 K-factor and vapor barrier.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which expansion compensation products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 EXPANSION JOINTS

A. Install expansion joints where indicated, and elsewhere as determined by Installer for adequate expansion of installed piping system. Install in accordance with manufacturer's instructions. Provide pipe anchors and pipe alignment guides as indicated, and in accordance with manufacturer's recommendations. Align units properly to avoid end loading and torsional stress.

3.3 EXPANSION LOOPS

A. Fabricate expansion loops to dimensions indicated, in locations indicated, for adequate expansion compensation of installed piping system. Provide pipe anchors and pipe alignment guides as indicated, to properly anchor and align piping in relationship to expansion loops.

3.4 EXPANSION COMPENSATION FOR RISERS AND TERMINALS

A. Install connection between piping mains and risers with at least five (5) pipe fittings including tee in main. Install connections between piping risers and terminal units with at least four (4) pipe fittings, including tee in riser.

3.5 INSTALLATION OF PIPE ALIGNMENT GUIDES

A. Install pipe alignment guides on piping that adjoins expansion joints and elsewhere as indicated.

B. Anchor to building substrate.

END OF SECTION 230516

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This Section includes potable cold, hot, and recirculated hot water valves within the building to a point 5-feet outside the building. This section includes the following:

1. Valves

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following:

1. Comply with ASME B16.10 and ASME B16.34 for Dimension and Design Criteria.
2. NSF Compliance: NSF 61 and NSF 372 for products that contact drinking water.
3. Local Plumbing Code and Utility Department requirements.
4. Colorado Cross Connection Control Manual.
5. Safe Drinking Water Act – Public Law No. 111-380.

1.3 INSTALLER'S QUALIFICATIONS

A. All Plumbing Work shall be performed by a State of Colorado Licensed Contractor under the supervision of a Licensed Plumber. Contractors shall verify that plumbers are currently licensed by the State of Colorado and shall supply the Project Manager with names and license numbers. Contractors shall have a minimum of three (3) years of satisfactory performance in conducting the type of work specified.

1.4 SUBMITTALS

A. Submit under provisions of Division 1.

1.5 CLOSEOUT SUBMITTALS

A. Submit under provisions of Division 1.

B. Test Reports.

C. Valve schedule listing valve designation number, valve type, size, location, and function of all valves.

PART 2 - PRODUCTS

2.1 VALVES

A. General:

1. Valves shall be NSF/ANSI 61 and NSF/ANSI 372 compliant for potable-water service. Valves for domestic water shall be 3rd Party Certified.
2. Comply with MSS-92 1980 "Valve Users Manual".
3. Sizes: Provide valves of same size as upstream pipe size.
4. Extended Stems: Where insulation is indicated or specified, provide extended stems to allow full operation of the valve without interference by the insulation.
5. Bypass and Drain Connections: Comply with MSS SP-45.
6. **[All valves shall be manufactured within the USA. No imported valves will be accepted. Documentation shall be provided with the submittal indicating compliance with the made in the USA requirement.]**

B. Gate Valves:

1. 2-1/2 Inch and Larger: Lead-free, MSS-SP 70, 200 PSI CWP, non-rising stem, bolted bonnet, resilient wedge, NSF epoxy coated ASTM A126 Class B cast iron body or ASTM A536 ductile iron body, handwheel operator.

a. Acceptable Manufacturers:

1) Nibco F-619-RW-LF
2) Watts
3) Kennedy Valve
4) Wilkens

C. Ball Valves:

1. 2-1/2 Inch and Smaller: MSS-SP-110, 150 PSI SWP, 600 PSI WOG, two-piece ASTM B-584 lead-free cast bronze body, full port, chrome plated brass/bronze ball, PTFE seats, anti-blowout stem, separate packnut with adjustable stem packing, extended stem, and vinyl covered steel handle. Threaded or soldered end connections. Valve shall be NSF/ANSI 61 and NSF/ANSI 372 compliant for potable-water service.

a. Acceptable Manufacturers:

1) Apollo (Conbraco) Model 77CLF (lead free)
2) Nibco
3) Milwaukee
4) Hammond

D. Butterfly Valves:

1. 2-1/2 Inch and Larger: MSS-SP-67, ASTM A126 cast iron body or ASTM A536 ductile iron body, Class B fully lugged, lead-free aluminum bronze disc, stainless steel stem, EPDM liner, bronze bearings, non-metallic bushing and EPDM or Buna-N stem seals. Rated for 200 PSI bi-directional shutoff and 200 PSI dead-end service with downstream piping removed. The valve design shall be for ANSI 125 or 150 flanges. Provide extended neck for insulation. Sizes 3-inch – 6-inch shall be lever operated with 10-position throttling plate; sizes 8-inch and larger shall have weatherproof gear operators. Valve shall be NSF/ANSI 61 and NSF/ANSI 372 compliant for potable-water service.

2.

a. Acceptable Manufacturers:

1) Nibco LD-2000N-3/5
2) Watts BF Series
3) Val Matic Valve – American BFV
4) Milwaukee
5) Hammond

E. Check Valves:

1. Swing Check Valve:

a. 2-1/2 Inch and Smaller: MSS SP-80; pressure rating 200 CWP, ASTM B-584 lead-free bronze body and bonnet, horizontal swing design, Y-pattern, with PTFE seat disc. Threaded or soldered end connections. Valve shall be NSF 61 and NSF/ANSI 372 compliant for potable-water service.

1) Acceptable Manufacturers:

a) Nibco T/S-413-Y-LF (lead-free)
b) Milwaukee
c) Hammond

b. 3-Inch and Larger: MSS SP-71; Class 125, ASTM A126 Class B cast iron body with bronze trim, non-asbestos gasket, horizontal swing, and flanged ends. Valve shall be capable of being refitted without removing from pipe. Valve shall be NSF 61 and NSF/ANSI 372 compliant for potable-water service.

1) Acceptable Manufacturers:

a) Nibco F-918-LF

F. Drain Valve: Lead-free bronze ball valve with threaded hose end and cap with chain. Valve upstream of backflow preventer shall have vacuum breaker and cap. MSS-SP-110, 150 PSI SWP, 600 PSI WOG, two-piece ASTM B-584 lead-free cast bronze body, full port, chrome plated brass/bronze ball, PTFE seats, anti-blowout stem, separate packnut with adjustable stem packing, extended stem, and vinyl covered steel handle. Threaded or soldered end connections. Valve shall be NSF/ANSI 61 and NSF/ANSI 372 compliant for potable-water service.

1. Acceptable Manufacturers:

a. Apollo 70LF-100/200-HC (lead-free)
b. Nibco
c. Milwaukee
d. Hammond

G. Calibrated Balancing Valves:

1. 200 PSI, lead-free brass body, brass ball construction or stainless steel cartridge, with handle and memory stop. Differential pressure read-out ports across valve seat.

a. Acceptable Manufacturers:

1) Bell & Gossett ITT Circuit Setter CB Lead-free series
2) Griswold Controls – K Valve

PART 3 - EXECUTION

3.1 VALVES

A. Installation:

1. Use gate valves only on domestic water service entrances as specified by the Authority Having Jurisdiction.
2. Use ball or butterfly valves for isolation valves unless noted otherwise.
3. Use ball valves for throttling or water meter bypass.
4. Use calibrated balancing valves for balancing valves.
5. Sectional Valves: Install sectional valves on each branch and riser, where branch or riser serves two (2) or more plumbing fixtures or equipment connections, and elsewhere as indicated.
6. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item, and stops on inlet of each plumbing fixture, and elsewhere as indicated.
7. Drain Valves: Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to completely drain distribution piping system.
8. Check Valves: Install check valves on discharge side of each pump, each side of reduced pressure backflow preventers and elsewhere as indicated.

9. Balancing Valves: Install in each hot water recirculating loop, discharge side of each pump, and elsewhere as indicated.
10. Chain Wheel Operators: For valves 2-1/2 inch and larger installed 96-inches or higher above finished floor elevation in mechanical rooms. Extend chains to an elevation of 6'-0" above finished floor elevation.

3.2 ADJUSTING AND CLEANING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLBG PIPING AND EQUIP

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of Supports and Anchors required by this section is indicated on drawings and/or specified in other Division 22 sections.

B. Types of Supports and Anchors specified in this section include the following:

1. Horizontal-Piping Hangers and Supports
2. Vertical-Piping Clamps
3. Hanger-Rod Attachments
4. Building Attachments
5. Thermal Shield Inserts and Protective Shields
6. Spring Hangers and Supports
7. Miscellaneous Materials
8. Anchors
9. Equipment Supports

C. Supports and anchors furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 22 sections.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. Regulatory Requirements: Comply with applicable Plumbing Codes pertaining to product materials and installation of supports and anchors.
2. MSS Standard Compliance:

a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing manufacturer's figure number, size, location, and features for each required pipe hanger and support.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

C. Product certificates signed by the manufacturer of hangers and supports certifying that their products meet the specified requirements.

D. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Pipe Hangers and Supports:

    a. B-Line Systems, Inc.
    b. Carpenter and Patterson, Inc.
    c. Fee & Mason Mfg. Co.; Division Figgie International
    d. PHD Manufacturing, Inc.
    e. Elcen Metal Products Company
    f. Erico/Caddy
    g. Unistrut Metal Framing Systems
    h. Hubbard Enterprises (Supports for domestic water piping)
    i. Hilti Construction Chemicals, Inc.
    j. Anvil

2. Thermal Shields:

    a. B-Line Systems, Inc.
    b. Pipe Shields, Inc.
    c. Insulation Pipe Supports Manufacturing
    d. Insulated Saddle Shield Insert Product Inc.
    e. Erico/Caddy
    f. Component Products Co.
    g. Value Engineered Products, Inc.
    h. Snappitz
    i. Anvil

3. Concrete Inserts and Anchors:

    a. Phillips Drill Company
    b. Erico/Caddy
    c. Elcen Metal Products Company
    d. ITW Ramset/Red Head
    e. Hilti Construction Chemicals, Inc.
    f. B-Line Systems, Inc.
    g. Blue Banger Hanger

2.2 PIPE HANGERS AND SUPPORTS

A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.

1. Components shall have galvanized coatings where installed for piping and equipment that will not have field-applied finish.
2. Pipe attachments shall have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

B. Adjustable Clevis Hanger: MSS Type 1

1. Steel Pipe, size 3/8-inch thru 12-inch, B-Line B3100
2. Copper Pipe, size 1/2-inch thru 4-inch, B-Line B3104CT
3. Cast Iron Pipe, size 4-inch thru 24-inch, B-Line B3100

C. Adjustable Swivel Ring: MSS Type 10

1. Steel Pipe, size 1/2-inch thru 2-inch, B-Line B3170NF
2. Copper Pipe, size 1/2-inch thru 4-inch, B-Line B3170CT

D. Pipe Clamps: MSS Type 8

1. Steel Pipe, size 3/4-inch thru 20-inch, B-Line B3373
2. Copper Pipe, size 1/2-inch thru 4-inch, B-Line B3373CT

E. Floor Standpipe Saddle Support: MSS Type 37

1. Steel Pipe, size 1 1/2-inch thru 12-inch, B-Line B3095

F. Hanger Rods: Continuous threaded steel, sizes as specified.

G. Pipe Alignment Guides:

1. Pipe Guides: Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

H. Multiple or Trapeze: Structural steel channel (with web vertical), with welded spacers and hanger rods. Provide hanger rods one (1) size larger than for largest pipe in trapeze. If the deflection at center of trapeze exceeds 1/360 of the distance between the end hangers, install an additional hanger at mid-span or use a larger channel.

I. Wall Supports for Horizontal Pipe:

1. 1/2-Inch thru 3-1/2 Inch: Steel offset hook.
2. 4-Inch and Over: Welded steel bracket and wrought steel clamp.

J. Supports for Vertical Pipe: Steel or Copper Coated riser clamp.

K. Upper Attachments:

1. Beam Clamps:

a. All thread rod sized 3/8-inch and ½-inch, B-Line B3034
b. All thread rod sizes 5/8-inch, B-Line B3033
c. All thread rod sizes ¾-inch and up, B-Line B3055

2.3 CONCRETE INSERTS AND ANCHORS

A. Inserts: Case shall be of galvanized carbon steel with square threaded concrete insert nut for hanger rod connection; 3/4-inch lateral adjustment; top lugs for reinforcing rods, nail holes for attaching to forms. Erico Hanger Models 355 and 355N or equal. This type of upper attachment is to be used for all areas having poured in place concrete construction.

1. Size inserts to suit threaded hanger rods.

B. Anchors: Carbon steel, zinc plated and coated with a clear chromate finish. Installation shall be in holes drilled with carbide-tipped drill bits or by use of self-drilling anchors.

1. Provide anchors suitable for the location of installation and designed to withstand all forces and movements acting in the anchor. Manufacture pipe anchors in accordance with MSS SP 58. Provide a safety factor of four (4) for the anchor installation.
2. Powder driven fasteners subject to approval of Structural Engineer. Each fastener shall be capable of holding a test load of 1,000 pounds whereas the actual load shall not exceed 50 pounds.
3. Self-drilling expansion shields. The load applied shall not exceed one-fourth the proof test load required.
4. Machine bolt expansion anchor. The load applied shall not exceed one-fourth the proof test load required.

2.4 THERMAL SHIELD INSERTS AND PROTECTIVE SHIELDS

A. General: Provide thermal shield inserts under all insulated piping hangers. Provide thermal shield inserts on all piping through floors, wall and roof construction penetrations. Size saddles and thermal shield inserts for exact fit to mate with pipe insulation or a minimum of 1-inch thick for uninsulated pipe thermal shield inserts.

B. Galvanized Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation. See also Part 3.H.3.

1. B-Line B3151

C. Thermal Shield Inserts: Provide 100-psi average compressive strength, waterproof, asbestos free calcium silicate, encased with galvanized steel protection shields or other listed system manufacturers. Insert and shield shall cover the entire circumference on vertical pipes, or the bottom half circumference of the pipe on horizontal mounting supports, and shall be of length recommended by the manufacturer for pipe size and thickness of insulation or the thickness of the wall, roof or floor construction.

NPS	Length	Metal Shield Thickness
1/4 thru 3-1/2	12	0.048
4	12	0.060
5 and 6	18	0.060
8 thru 14	24	0.075
16 thru 24	24	0.105

D. Thermal Mechanical Pipe Shields: Self-locking insulated pipe supports/shields shall be provided at hanger, support, and guide locations on pipe requiring insulation. The insert shall consist of either hydrous calcium silicate or polyisocyanurate foam insulation (urethane) encircling the entire circumference of the pipe with a 360 degree PVC or galvanized steel jacket which complies with the International Mechanical Code for installation in plenum ceilings where applicable. The length of the jacket shall be sized for pipe expansion.

2.5 SPRING HANGERS AND SUPPORTS

A. General: Provide factory-fabricated spring hangers and supports complying with MSS SP-58, of one (1) of the following MSS types listed, selected by Installer to suit piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one (1) type by one (1) manufacturer for each piping service. Select spring hangers and supports to suit pipe size and loading.

B. Restraint Control Devices: MSS Type 47

C. Spring Cushion Hangers: MSS Type 48

D. Spring Sway Braces: MSS Type 49

E. Variable Spring Hangers: MSS Type 51; preset to indicated load and limit variability factor to 25 percent.

F. Variable Spring Base Supports: MSS Type 52; preset to indicated load and limit variability factor to 25 percent; include load flange.

G. Variable Spring Trapeze Hangers: MSS Type 53; preset to indicated load and limit variability factor to 25 percent.

H. Constant Supports: Provide one (1) of the following types, selected to suit piping system. Include auxiliary stops for erection and hydrostatic test, and field load-adjustment capability.

1. Horizontal Type: MSS Type 54
2. Vertical Type: MSS Type 55
3. Trapeze Type: MSS Type 56

2.6 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

C. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS Standards.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments. **Review Structural Drawings to obtain structural support limitations.**

B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at Project Site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified. **Provide Shop Drawing showing method and support locations from structure.**

3.3 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments within concrete or on structural steel. Space attachments within maximum piping span length indicated in MSS SP-69 and tables in this section. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.

B. New Construction:

1. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

2. Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 4-inch.
3. Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
4. Use drop-in anchors for concrete structures.
5. Use beam clamps for steel structures.

C. Existing Construction:

1. In existing concrete construction, drill into concrete slab and insert and tighten expansion anchor bolt. Connect anchor bolt to hanger rod. Care must be taken in existing concrete construction not to sever reinforcement rods or tension wires.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69 and SP-89. Arrange for grouping of parallel runs of horizontal piping to be supported together on field fabricated, heavy-duty trapeze hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.

C. Support fire-water piping independently from other piping systems.

D. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

E. Install hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, to facilitate action of expansion joints, expansion loops, expansion bends and similar units and within 1'-0" of each horizontal elbow.

F. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

G. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31.9 Building Services Piping Code is not exceeded.

H. Install steel natural gas piping with the following minimum rod size and maximum spacing.**:**

Size (NPS)(Inches)	Maximum Span in Feet	Minimum Rod Size - Inches
1/2	6	3/8
3/4 to 1-1/4	8	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 5	10	5/8
6 to 8	10	3/4
10 to 12	10	7/8
Vertical, all sizes	Every floor level	

I. Install horizontal water distribution piping with the following maximum hanger spacing and minimum rod sizes:

Nom. Pipe Size - Inches	Steel Pipe Max. Span - Feet	Copper Tube and DWV Copper Max. Span - Feet	Min. Rod Diameter - Inches
Up to 1/2	6	6	3/8
3/4 & 1	8	6	3/8
1-1/4	10	6	3/8
1-1/2	10	6	3/8
2	10	10	3/8
2-1/2	10	10	1/2
3	10	10	1/2
4	10	10	5/8
5	10	10	5/8
6	10	10	3/4
8	10	10	3/4

J. Install storm drains, sanitary drainage and vent systems with the following maximum spacing and minimum rod sizes:

Pipe Size	CAST IRON PIPE – HUB AND SPIGOT AND NO-HUB		
	Maximum Hanger Spacing (ft.)	Maximum Vertical Spacing (ft.)	Minimum Rod Size (in.)
1-1/4" to 2"	5	15	3/8
2-1/2" to 5"	5	15	1/2
6"	5	15	5/8
8" to 12"	5	15	3/4
14" to 16"	5	15	1

Based on MSS-69 & IPC.
Provide midstory guides for piping 2 inches and smaller.

K. Support horizontal cast iron pipe as follows:

1. Hub and Spigot: All sizes - One (1) hanger to each joint.
2. No-Hub: All sizes.

   a. With ASTM C 1540 stainless steel couplings: One (1) hanger to each joint.
   b. With all other stainless steel band type couplings: One (1) hanger to each side of joint.
   c. Support all horizontal cast iron pipe within 18-inches of each joint and with 5-feet maximum spacing between hangers, except that pipe exceeding 5-feet in length shall be supported at intervals no greater than 10-feet.
   d. Support vertical cast iron pipe at each story height and at its base. Secure vertical hub and spigot pipe immediately below the hub. Support vertical no-hub pipe so that the weight is carried from the pipe to the support and not from the joint to the support.

L. Provide copper or copper plated hangers and supports for copper piping.

M. Place a hanger within 1-foot (0.305 m) of each horizontal elbow.

N. Use hangers which are vertically adjustable 1-1/2 inch (38.1 mm) minimum after piping is erected.

O. Support vertical steel and copper piping at every story height but at not more than 15-foot intervals for steel and 10-feet for copper.

P. Where several pipes can be installed in parallel and at same elevation, provide trapeze hangers.

Q. Support riser piping independently of connected horizontal piping.

R. All insulated pipes (≥ 2"d) shall have thermal shield insert at all support points. All piping shall have thermal shield inserts at each penetration through wall, floor and roof.

S. Each pipe drop to equipment shall be adequately supported. All supporting lugs or guides shall be securely anchored to the building structure.

T. Securely anchor and support plumbing domestic water piping in chases or walls. Use factory manufactured clamps and brackets connected to fixture carriers, waste/vent piping or brackets connected to studs. Wires or straps will not be permitted.

1. When copper supplies are connected to flush valves, support the tubing by the studs or by a fixture carrier, not by clamping to waste/vent piping.
2. Prevent copper tubes from making contact with steel brackets using fire retardant polyethylene inserts or other dielectric insulating material.
3. Place supports every 10-feet on vertical pipe and every 5-feet on horizontal pipe.

U. Hang all insulated pipe at the point of support in the following manner:

1. Hanger: See Paragraph 2.2.
2. Thermal Shield/Insert: Provide thermal shield insert of the same thickness as adjoining insulation for insulated pipe. The entire 360 degrees shall be waterproof, asbestos free, calcium silicate or polyisocyanurate foam insulation (urethane).

    a. All hangers shall be properly sized to accommodate the thermal shield insert and no hanger shall penetrate or crush any of the insulating material.

V. Install anchors and fasteners in accordance with manufacturer's recommendations and the following:

1. In the event a self-drilling expansion shield or machine bolt expansion shield is considered to have been installed improperly, the Contractor shall make an acceptable replacement or demonstrate the stability of the anchor by performing an on-site test under which the anchor will be subjected to a load equal to twice the actual load.
2. Powder-driven fasteners may be used only where they will be concealed after the construction is complete. Where an occasional fastener appears to be improperly installed, additional fastener(s) shall be driven nearby (not closer than six (6) inches) in undisturbed concrete. Where it is considered that many fasteners are improperly installed, the Contractor shall test load any fifty (50) successively driven fasteners. If 10 percent or more of these fasteners fail, the Contractor shall utilize other fastening means as approved and at no additional cost to the Owner.
3. Hangers for piping shall be attached to cellular steel floor decks with steel plates and bolted rod conforming to the steel deck manufacturer's requirements. Where the individual hanger load exceeds the capacity of a single floor deck attachment, steel angles, beams or channels shall be provided to span the number of floor deck attachments required.
4. Welding may be used for securing hangers to steel structural members. Welded attachments shall be designed so that the fiber stress at any point of the weld or attachment will not exceed the fiber stress in the hanger rod.

3.5 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31.9, and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31.9 and with AWS Standards D1.1.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to control movement to compensators.

D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.6 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.

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 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and 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 that no roughness shows after finishing.

3.7 ADJUSTING

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

B. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces.

1. Touch-Up Painting: Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of the shop paint on miscellaneous metal is specified in Division 9 section "PAINTING" of these specifications.

C. For galvanized surfaces, clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 220529

SECTION 220548 - VIBRATION CONTROL FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of Vibration Control Work required by this section is indicated on Drawings and Schedules, and/or specified in other Division 23 sections.

B. Types of Vibration Control Products specified in this section include the following:
   1. Isolation Hangers
   2. Riser Isolators
   3. Flexible Pipe Connectors

C. Vibration Control Products furnished as integral part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 22 sections.

D. Refer to other Division 22 sections for equipment foundations; Hangers; Sealants; Gaskets; requirements of electrical connections to equipment isolated on vibration control products; requirements of duct connections to air handling equipment isolated on vibration control products.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control products, of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than five (5) years.

   1. Except as otherwise indicated, obtain Vibration Control Products from single manufacturer.
   2. Engage Manufacturer to provide technical supervision of installation of support isolation units produced, and of associated inertia bases (if any).

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of vibration control product. Submit schedule showing size, type, deflection, and location for each product furnished.

   1. Include data for each type and size of unit, showing isolation efficiency, stiffness, natural frequency and transmissibility at lowest operating speed of equipment.
   2. For spring units, show wire size, spring diameter, free height, solid-compression height, operating height, fatigue characteristics, ratio of horizontal to vertical stiffness and bases of spring-rated selection for range of loading weights.
   3. Include performance certifications from manufacturers.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weights, required clearances, and method of assembly of components. Detail bases and show location of equipment anchoring points coordinated with equipment manufacturer's shop drawings.

1. Shop drawings showing structural design and details of inertia bases, steel beam bases and other custom-fabricated work not covered by manufacturer's submitted data.

a. Furnish templates, anchor bolts and sleeve for equipment bases, foundations and other support systems for coordination of vibration isolation units with other work.

2. Submit shop drawings indicating scope of vibration isolation work and locations of units and flexible connections. Include support isolation points for piping and ductwork including risers, air housings and inertia bases.

a. Include schedule of units, showing size or manufacturer's part number, and weight supported and resulting deflection of each unit.

C. Maintenance Data: Submit maintenance data for each type of vibration control product. Include this data, product data and shop drawings in maintenance manual; in accordance with requirements of Divisions 1.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

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

1. Vibration Control Products:

a. Mason Industries, Inc.
b. Peabody Noise Control, Inc.
c. Vibration Eliminator
d. Senior Flexonics

2.2 VIBRATION CONTROL MATERIALS AND SUPPORT UNITS

A. Isolation Hangers: Hanger units formed with brackets and including manufacturer's standard compression isolators of type indicated. Design brackets for five (5) times rated loading of units. Fabricate units to accept misalignment of 15 degree off center in any direction before contacting hanger box, and for use with either rod or strap type members, and including acoustical washers to prevent metal-to-metal contacts.

1. Provide vibration isolation spring Type C with cap in lower pad-type isolator rubber hanger element in bottom, securely retained in unit.

2. Provide neoprene element, with minimum deflection of 0.35-inch, securely retained in hanger box.

    a. Mason Industries Type 30N

B. Riser Isolators: Suspend risers from, or support risers by, spring hangers Type ND or spring isolators Type F. Wherever possible, anchor risers at central point with resilient anchors, Type D. Provide hanger or mounting deflection of 0.75-inch except in those expansion locations where additional deflection is required to limit deflection or load changes to +25 percent of initial deflection. Provide sliding guides held in position by resilient anchors, located between anchor points and end of piping, spaced as indicated.

C. Flexible Pipe Connectors:

1. For Non-Ferrous Piping, provide bronze hose covered with bronze wire braid with copper tube ends or bronze flanged ends, braze-welded to hose.

    a. Mason Industries Type BBF

2. For Ferrous Piping, provide stainless steel hose covered with stainless steel wire braid with NPT steel nipples or 150 PSI ANSI flanges, welded to hose.

    a. Mason Industries Type BSS

[OR]

3. Flexible Pipe Connectors: Provide EDPM construction consisting of multiple plies of Kevlar cord fabric and elastomer molded and peroxide cured in hydraulic rubber presses, rated for 125 PSI at 220 degree F (104 degree C).

    a. Mason Industries Type SFDEJ

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which vibration control units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Owner or his representative.

3.2 PERFORMANCE OF ISOLATORS

A. General: Comply with minimum static deflections recommended by ASHRAE, for selection and application of vibration isolation materials and units as indicated.

B. Manufacturer's Recommendations: Except as otherwise indicated, comply with manufacturer's recommendations for selection and application of vibration isolation materials and units to achieve minimum static deflection and displacement requirements.

3.3 APPLICATIONS

A. General: Except as otherwise indicated, select vibration control products in accordance with ASHRAE Handbook, 1999 HVAC Applications Volume, Chapter 42 "Sound and Vibration Control", Table 34.

B. Piping: For piping connected to equipment mounted on vibration control products, install isolation hangers Type N, as indicated, and for first three (3) points of support for pipe sizes 4-inch and less, for first four (4) points of support for pipe sizes 6-inch through 8-inch, and for first six (6) points of support for pipe sizes 10-inch and over.

C.

1. Where applicable, apply restraint system in accordance with SMACNA GFSR 1982.

3.4 INSTALLATION

A. General: Except as otherwise indicated, comply with manufacturer's instructions for installation and load application to vibration isolation materials and units. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation.

B. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces.

C. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.

D. Install inertia base frames on isolator units so that minimum of 1-inch clearance below base will result when frame is filled with concrete and supported equipment has been installed and loaded for operation.

E. Locate isolation hangers as near overhead support structure as possible.

F. Weld riser isolator units in place as required to prevent displacement from loading and operations.

G. Flexible Pipe Connectors: Install on equipment side of shutoff valves, horizontally and parallel to equipment shafts wherever possible.

3.5 EXAMINATION OF RELATED WORK

A. Installer of vibration isolation work shall observe installation of other work related to vibration isolation work, including work connected to vibration isolation work; and, after completion of other related work (but before equipment start-up), shall furnish written report to Engineer listing observed inadequacies for proper operation and performance of

vibration isolation work. Report shall cover, but not necessarily be limited to the following:

1. Equipment installations (performed as work of other sections) on vibration isolators.
2. Piping connections, including flexible connections.
3. Passage of piping, which is to be isolated through walls and floors.

B. Do not start-up equipment until inadequacies have been corrected in manner acceptable to vibration isolation installer.

3.6 ADJUSTING AND CLEANING

A. Clean each vibration control unit, and verify that each is working freely, and that there is no dirt or debris in immediate vicinity of unit that could possibly short-circuit unit isolation.

3.7 DEFLECTION MEASUREMENTS

A. Upon completion of vibration isolation work, prepare report showing measured equipment deflections theoretical floor deflection and isolation efficiency for each major item of equipment.

END OF SECTION 220548

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of Mechanical Identification Work required by this section is indicated on drawings and/or specified in other Division 22 sections.

B. Types of Identification Devices specified in this section include the following:

1. Painted Identification Materials
2. Plastic Pipe Markers
3. Plastic Tape
4. Underground-Type Plastic Line Marker
5. Valve Tags
6. Valve Schedule Frames
7. Engraved Plastic-Laminate Signs
8. Plasticized Tags
9. Lettering and Graphics

C. Refer to Division 26 sections for Identification Requirements of Electrical Work; not work of this section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), size of valve, and variations for identification (if any). Only tag valves which are intended for emergency shutoff and similar special uses, such as valve to isolate individual system risers, individual floor branches or building system shut-off valves. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Allen Systems, Inc.
2. Brady (W.H.) Co.; Signmark Division
3. Brimar Industries, Inc.
4. Industrial Safety Supply Co., Inc.
5. Seton Name Plate Corp.

2.2 MECHANICAL IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 22 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.3 PAINTED IDENTIFICATION MATERIALS

A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping or to match existing size in existing building, but not less than 3/4-inch high letters for access door signs and similar operational instructions.

B. Stencil Paint: Standard exterior type stenciling enamel; Black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

C. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated, comply with ANSI A13.1 for colors or to match existing building standard identification.

2.4 PLASTIC PIPE MARKERS

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.

B. Insulation: Furnish 1-inch thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degree F (52 degree C) or greater. Cut length to extend 2-inch beyond each end of plastic pipe marker.

C. Small Pipes: For external diameters less than 6-inch (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one (1) of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4-inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inch.

D. Large Pipes: For external diameters of 6-inch and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than three (3) times letter height (and of required length), fastened by one (1) of the following methods:

1. Steel spring or non-metallic fasteners.
2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inch wide; full circle at both ends of pipe marker, tape lapped 3-inches.
3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

E. Lettering: Comply with piping system nomenclature as specified, scheduled, shown, or to match existing building lettering nomenclature system and abbreviate only as necessary for each application length.

F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.5 PLASTIC TAPE

A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2 inch wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6-inch, 2-1/2 inch wide tape for larger pipes.

C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.6 UNDERGROUND-TYPE PLASTIC LINE MARKERS

A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6-inch wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe.

B. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.7 VALVE TAGS

A. Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4-inch high letters and sequenced valve numbers 1/2-inch high, valve normal position 1/4-inch high letters, and with 5/32-inch hole for fastener.

1. Provide 1-1/2 inch diameter tags, except as otherwise indicated.
2. Fill tag engraving with Black enamel.

B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), and solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

C. Access Panel Markers: Provide manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8-inch center hole to allow attachment.

2.8 VALVE SCHEDULE

A. Valve Schedule shall be printed on company letterhead and shall include the following columns:

1. Valve Tag Number (*example*: HWS-1)
2. Service (*example*: ISOLATE AHU-1 HEATING COIL)
3. Room Number (location of valve)
4. Size of Valve
5. Type of Valve
6. Normal Position of the Valve (open or closed)

B. Frame: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with non-glare type plexiglass.

2.9 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, Black with White core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/8-Inch, except as otherwise indicated.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.10 PLASTICIZED TAGS

A. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4 inch x 5-5/8 inch, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (As examples; DANGER, CAUTION, DO NOT OPERATE).

2.11 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified, scheduled and approved by the Owner/Engineer. Provide numbers, lettering and wording as indicated and approved by the Owner/Engineer for proper identification and operation/maintenance of mechanical systems and equipment.

B. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as designated on the drawings or schedule as well as service.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers of the following type on each system indicated to receive identification, and include arrows to show normal direction of flow. Existing building identification shall match the existing method which exists in the building.

B. Plastic pipe markers, with application system as indicated under "MATERIALS" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.

C. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

D. Near each valve and control device.

E. Near each branch, excluding short take-offs for fixtures; mark each pipe at branch, where there could be question of flow pattern.

F. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.

G. At access doors, manholes and similar access points which permit view of concealed piping.

H. Near major equipment items and other points of origination and termination.

I. Spaced intermediately at maximum spacing of 25-foot along each piping run, except reduce spacing to 15-foot in congested areas of piping and equipment.

J. On piping above removable acoustical ceilings.

3.3 UNDERGROUND PIPING IDENTIFICATION

A. General: During back-filling/top-soiling of each exterior underground piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6-inch to 8-inch below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16-inch, install single line marker. For tile fields and similar installations, mark only edge pipelines of field.

3.4 VALVE IDENTIFICATION

A. General: Provide valve tag on valves in each piping system. List each tagged valve in valve schedule for each piping system.

1. Building services main shutoff valves.
2. Each individual system main shutoff valves.
3. Each individual system riser shutoff valves.
4. Each individual system floor shutoff valves.
5. Each individual system major branch shutoff valves.

B. Provide the following columns and information for each valve:

1. Valve Tag Number (*example*: HWS-1)
2. Service (*example*: ISOLATE AHU-1 HEATING COIL)
3. Room Number (location of valve)
4. Size of Valve
5. Type of Valve
6. Normal Position of the Valve (open or closed)

C. Mount valve schedule frames and schedules in mechanical equipment rooms where directed by Architect/Owner/Engineer.

D. Where more than one (1) major mechanical equipment room is shown for project, install mounted valve schedule in each major mechanical equipment room, and repeat only main valves which are to be operated in conjunction with operations of more than single mechanical equipment room.

3.5 MECHANICAL EQUIPMENT IDENTIFICATION

A. General: Install minimum 2-inch x 4-inch engraved plastic laminate equipment marker on each individual items of mechanical equipment. Provide signs for the following general categories of equipment.

1. Main building systems control and operating valves, including safety devices and hazardous units such as gas outlets.
2. Fuel-burning units including boilers, water heaters, medical gas equipment.
3. Pumps, and similar motor-driven units.

4. Heat exchangers, and similar equipment.
5. Tanks and pressure vessels.
6. Water treatment systems and similar equipment.

B. Lettering Size: Minimum 1/4-inch high lettering for name of unit.

C. Text of Signs: In addition to the identified unit, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.6 ADJUSTING AND CLEANING

A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This Section includes:

1. Piping Insulation, Jackets and Accessories
2. Equipment Insulation and Covering

B. Refer to other Division 22 sections for Shields, Inserts, and Mechanical Identification.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than three (3) years.

B. Installer's Qualifications: Firm with at least five (5) years successful installation experience on projects with mechanical insulations similar to that required for this project.

C. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulating cements.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's installation instructions and schedule listing materials, thickness, K-value, density, and furnished accessories for each service or equipment specified.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard ratings of the products, name of manufacturer, and brand.

B. Protect insulation against dirt, water, chemical, and mechanical damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide product by one of the following:

1. Insulation:

a. Armstrong World Industries, Inc. (flexible elastomeric)
b. Johns-Manville Products Corp. (fiberglass, calcium silicate)
c. Knauf Fiber Glass (fiberglass)
d. Manson Insulation Co. (fiberglass, calcium silicate)
e. Owens-Corning Fiberglas Corp. (fiberglass)
f. Rubatex Corp. (flexible elastomeric)
g. Aeroflex (flexible elastomeric)

2. Jacketing, Coatings, Adhesives, Sealants and Covering Products:

a. Childers
b. Foster
c. Ceel-Co.
d. Johns-Manville Products Corp.
e. Knauf Fiber Glass
f. Venture Tape Corporation
g. Design Polymetrics

2.2 PIPING INSULATION

A. Glass Fiber: ASTM C 547, Type 1, rigid molded, noncombustible, 0.23 "K" value at 100 degree F mean temperature, maximum service temperature 850 degree F, moisture sorption less than 0.2% by volume. Composite 25/50-flame spread/smoke developed rating (ASTM E 84, UL 723, and NFPA 255).

B. Vapor Retarder Jacket: ASTM C 1136, 45lbs/in tensile strength (ASTM D 828), or beach puncture 50 oz in/in tear minimum (ASTM D 781). White Kraft paper reinforced with glass fiber yarn and bonded to aluminum foil, secured with self-sealing longitudinal laps and butt strips.

C. Connections: Tacks, pressure sensitive color matching vinyl tape, Perma-Weld adhesive.

D. Calcium Silicate: ASTM C 533, Type I, rigid molded, noncombustible (ASTME E 136), 0.42 "K" value at 300 degree F mean temperature, maximum service temperature 1200 degree F, 160 psi compressive strength for 5 percent compression (ASTM C 165), flexural strength 70 psi (ASTM C 203). 0/0 flame spread/smoke developed rating (ASTM E 84).

E. Tie Wire: 16-Gauge stainless steel with twisted ends on maximum 12-inch centers.

F. Flexible Elastomeric Foam: ASTM C 534, Type I, flexible, cellular elastomeric, molded, 0.27 "K" value at 75 degree F mean temperature, maximum service temperature 220 degree F, water vapor permeability of 0.10 perm-inch, 25/50-flame spread/smoke developed rating (ASTM E 84, UL 723, and NFPA 255).

G. Field Applied Fittings and Jackets:

1. PVC Plastic:

a. One-piece, gloss white, molded fitting covers with factory installed fiberglass insulation inserts.
b. 20 Mil (30 mil for exterior applications) cut and curled gloss white jacketing material. Composite 25/50 flame spread/smoke developed rating (ASTM E84, UL 723 and NFPA 90A).
c. Connect with tacks and pressure sensitive color matching vinyl tape.

2. Stainless Steel: Type 304 stainless steel, 0.010-inch.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions where mechanical insulation is to be installed. Do not proceed until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PLUMBING PIPING INSULATION

A. Cold Piping:

1. Applications:

a. Potable and non-potable cold water.
b. Interior aboveground storm water.
c. Interior above ground overflow storm piping within six (6) lineal feet of roof bowl.
d. Plumbing vents within six (6) lineal feet of roof outlet.
e. Roof and overflow drain bowls.

2. Insulation:

a. Fiberglass: 1/2-Inch thickness up to 1-1/4 inch pipe size, 1-inch thickness for 1-1/2 inch pipe size and larger.

B. Hot Piping:

1. Applications:

a. Potable hot water.

b. Potable hot water and hot water circulation.
c. Hot equipment drain.

2. Insulation:

a. Hot water and circulating water; Fiberglass: Piping insulation shall be 1-inch thickness for pipes up to and including 1 1/4 inch and 1 1/2 inch for all other sizes.

3.3 INSTALLATION OF PIPING INSULATION

A. Install insulation after piping system tests have been completed.

B. Clean piping to remove foreign substances and moisture prior to applying insulation.

C. Install insulation products according to manufacturer's written instructions, building codes, and recognized industry standards.

D. Omit insulation on exposed chrome-plated piping (except for handicapped fixtures), air chambers, unions, balance cocks, flow regulators, drain lines from water coolers, drainage piping located in crawl spaces or tunnels, buried piping, fire protection piping, and pre-insulated equipment.

E. Secure longitudinal jacket laps and butt strips according to manufacturer's recommendations.

F. Firmly rub lap and butt strips to pressurize seam and ensure positive closure.

G. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use scraps.

H. Apply insulation to piping with all joints tightly fitted to eliminate voids.

I. Apply insulation on cold surfaces with a continuous, unbroken vapor seal. Hangers, supports, and anchors that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation.

J. Extend surface finishes to protect all surfaces, end, and raw edges of insulation.

K. Protect vapor-barrier jackets on pipe insulation from puncture or other damage. Avoid the use of staples on vapor barrier jackets. Seal vapor barrier penetrations with vapor barrier coating.

L. Cover valves, fittings and similar items with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded or job fabricated covers (at Installer's option). Coat all below ambient valves, fittings and similar items with vapor barrier coating and reinforcing mesh before application of PVC covers.

M. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where fire-stopping materials are required.

N. Provide thermal shield inserts on all pipe (Refer to 220529). For piping below ambient temperature, apply vapor barrier lap cement on butt joints and seal with 3-inch wide vapor barrier tape.

1. Minimum insulation insert lengths:

a. 1-1/2 – 2-1/2 Inch Pipe: 10-Inches
b. 3 – 6-Inch Pipe: 12-Inches
c. 8 – 10-Inch Pipe: 16-Inches

O. Apply galvanized metal shields between hangers or supports and pipe insulation. Form shields to fit the insulation and extend up to the centerline of the pipe. The shield length shall be 4-inches less than the associated insulation hanger insert to allow for vapor retarding butt joints on each side of the shields.

P. Apply adhesives, mastics and coatings at manufacturer's recommended minimum coverage per gallon.

Q. Replace all damaged insulation in whole; Repair of damaged insulation will not be accepted.

R. Insulate fittings and valves with PVC insulated fitting covers and insulation inserts per manufacturer's recommendations.

3.4 INSTALLATION OF EQUIPMENT INSULATION

A. Install insulation products according to manufacturer's instructions, building codes, and recognized industry standards.

B. Apply insulation as close as possible to equipment by grooving, scoring, and beveling insulation, if necessary. As required, secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands

C. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment use vapor retardant cement

D. Provide insulated dual temperature or cold equipment containing fluids below ambient temperature with vapor retardant jackets

E. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

F. Do not apply insulation to equipment, mufflers, breechings, or stacks while hot.

G. Apply insulation using staggered joint method and double layer construction. Apply each layer of insulation separately.

H. Cover insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over with wire netting and joints with 1/4-inch thick cement to remove surface irregularities.

I. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2-inch. Apply over vapor barrier where applicable.

J. Do not insulate manholes, handholes, cleanouts, ASME stamp, or manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

K. Provide removable insulation sections with aluminum jacket and stainless steel bands to cover parts of equipment which must be opened for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

L. Provide aluminum jacketing on exterior insulated equipment as recommended by manufacturer. On flexible elastomeric insulation, apply two (2) coats of manufacturer's approved U.V. resistant finish.

3.5 EXISTING INSULATION REPAIR

A. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This Section includes potable cold, hot, and recirculated hot water piping, fittings, and specialties within the building to a point 5-feet outside the building. This section includes the following:

1. Pipe and Tube Materials:

a. Above Grade, inside buildings.
b. Below Grade, inside buildings.

1.2 DEFINITIONS

A. Water Distribution Piping: A pipe within the building or on the premises, which conveys water from the water service pipe or meter to the points of usage.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following:

1. ASME B 31.9 "Building Services Piping" for materials, products and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
2. ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualification" for Qualifications for Welding Processes and Operators.
3. Comply with ANSI B31 Code for Pressure Piping.
4. Local Plumbing Code and Utility Department requirements.
5. Comply with NSF 61: Drinking Water System Components - Health Effects; Sections 1 through 9," For Potable Domestic Water Piping and Components; NSF 61 Annex G or NSF 372.
6. Colorado Cross Connection Control Manual.
7. Safe Water Drinking Act – Including Public Law 111-380 – Cited as the "Reduction of Lead in Drinking Water Act".

B. All piping systems shall be installed to manufacturer's standards and in accordance with the pipe manufacturer's instructions. Contractor shall demonstrate prior to installation of any piping that joining methods and procedures are acceptable to the Engineer and/or Owner with the Factory Representative present. During the installation of the piping system, the Contractor shall be required to provide joint coupons as requested by the Owner or Engineer and repair and/or replace system if joints are deemed unsatisfactory.

1.4 INSTALLER'S QUALIFICATIONS

A. All Plumbing Work shall be performed by a State of Colorado Licensed Contractor under the supervision of a Licensed Plumber. The General Contractor shall verify that plumbers are currently licensed by the State of Colorado Plumbing Contractors shall have a minimum of three (3) years of satisfactory performance in conducting the type of work specified.

1.5 SUBMITTALS

A. Submit under provisions of Division 1.

1.6 CLOSEOUT SUBMITTALS

A. Submit under provisions of Division 1.

B. Test Reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers:

1. Chlorinated Poly Vinyl Chloride Pipe and Fittings:

a. Charlotte Pipe and Foundry
b. Harvel Plastics, Inc.
c. Nibco
d. Cresline
e. IPEX

2. Grooved Coupling:

a. Victaulic Company

2.2 PIPE AND TUBE MATERIALS

A. Above Grade Inside Buildings:

1. Pipe 4-Inch and Smaller: ASTM B 88; Type L lead-free hard drawn copper tube.

a. Fittings:

1) Lead-Free Wrought Copper Solder-Joint Fittings: ASME B16.22.
2) Lead-Free Cast Copper Solder-Joint Fittings: ASME B16.18.

3) Lead-Free Cast Copper Alloy Flanges Class 150 and 300, Flat-Face Type: ASME B16.24.
4) Contractor Option: Mechanical Pressure-Seal fittings shall be lead-free. Fitting shall be press type with EPDM sealing elements. Contractor shall order valves and other components that are compatible with this press system. Solder joints are acceptable where press system is not the appropriate application.

b. Joining Material:

1) Lead-Free Solder: ASTM B32; minimum tensile strength of 5,900 psi. Solder shall be certified to meet NSF 61 Annex G or NSF 372.

c. Fluxes:

1) ASTM B813, Lead-Free Water Soluble, Liquid or Paste Type and be certified to meet NSF 61 Annex G or NSF 372.

B. Below Grade Inside Buildings:

1. Pipe 2-1/2 Inch and Smaller: ASTM B 88; Type K lead-free soft copper or Type K lead-free annealed copper tube.

a. Fittings:

1) Lead-Free Wrought Copper Solder-Joint Fittings: ANSI B16.22.
2) Lead-Free Cast Copper Solder-Joint Fittings: ASME B16.18.

b. Joining Material:

1) Brazing: ANSI/AWS A5.8.
2) Lead-free.
3) Brazing rods containing cadmium shall not be used.

c. Fluxes:

1) ANSI/AWS A5.31, Type FB3-A or FB3-C.

2. Pipe 3-Inch and Larger:

a. Ductile Iron Pipe: Class 52, ANSI A21.51; AWWA C151; 350 PSI pressure rating.

1) Cement Mortar Lining for Ductile Iron and Gray Iron Pipe and Fittings for Water: ANSI A21.4; AWWA C104.
2) Polyethylene Encasement for Gray and Ductile Cast Iron Piping: ANSI A21.5; AWWA C105.
3) Fittings:
a) Gray Iron Fittings: ANSI/AWWA C110/A21.10.
b) Ductile Iron Fittings: ANSI/AWWA C110/A21.10.

4) Joint Materials: Rubber gasket joints. ANSI/AWWA C111/A21.11.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Install pipes and pipe fittings in accordance with recognized industry practices to achieve permanently leak proof piping systems, capable of performing service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/ replacement of valves and equipment. Reduce sizes by use of reducing fittings. Align piping accurately at connections, within 1/16-inch misalignment tolerance.

B. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures. Only piping serving this type of equipment space shall be allowed.

C. Use fittings for all changes in direction and all branch connections.

D. Install piping straight, plumb, level and at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

F. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Install piping free of sags or bends and allow sufficient space above removable ceiling panels to allow for panel removal.

G. Locate groups of pipes parallel to each other, spaced to permit application of insulation and servicing of valves.

H. Install means to drain the system at all low points in mains, risers, and branch lines.

I. Fire and Smoke Wall Penetrations: Maintain the fire and smoke rated integrity where pipes pass through fire and smoke rated walls, partitions, ceilings, and floors.

J. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Use steel pipe for sleeves 6-inch and smaller. Use sheet metal for pipe sleeves 6-inch and larger.

K. Coordinate foundation and all other structural penetrations with Structural Engineer.

L. Install pipe ends clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket seating.

M. Install mechanical couplings and grooved piping systems per the manufacturer's installation instructions.

N. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

3.2 UNDERGROUND PIPE INSTALLATION

A. Clean fittings, nipples and other field joints thoroughly before coating.

B. Cast Iron Pipe:

1. Protect gray and ductile cast iron pipe installed below grade with polyethylene encasement applied in accordance with ANSI/AWWA C105/A21.5.
2. Install ductile iron pipe below grade as prescribed by AWWA C600.

C. Provide and install concrete thrust block and 3/4-inch steel threaded tie bar at each direction change on underground pressure pipe. Embed tie bar in thrust block and connect to upstream fitting. Paint tie bar with two (2) coats of Bitumastic #50 paint.

D. Bury all outside water piping minimum 5'-0" below grade to top of pipe.

3.3 SERVICE ENTRANCE

A. Extend water distribution piping 5'-0" outside of building.

B. Install sleeve and mechanical sleeve seal at penetrations through foundation wall for watertight installation.

C. Install shutoff valve at service entrance inside building; complete with strainer, pressure gauge, and test tee with valve.

3.4 EQUIPMENT CONNECTIONS

A. Piping Runouts to Fixtures: Provide hot and cold water piping run outs to fixtures of sizes indicated, but in no case smaller than required by Plumbing Code.

B. Mechanical Equipment Connections: Provide shutoff valve and union for each connection, provide drain valve on drain connection. For connections 2-1/2 inch and larger, use flanges instead of unions.

3.5 FIELD QUALITY CONTROL

A. Inspections: Inspect water distribution piping as follows:

1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the Authority Having Jurisdiction.
2. During the progress of the installation, notify the Plumbing Official Having Jurisdiction, at least forty-eight (48) hours prior to the time such inspection must be made. Perform tests specified below in the presence of the Plumbing Official.

a. Rough-In Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
b. Final Inspection: Arrange for a final inspection by the Plumbing Official to observe the tests specified below and to insure compliance with the requirements of the Plumbing Code.

3. Reinspections: Whenever the Plumbing Official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the Plumbing Official.
4. Reports: Prepare inspection reports, signed by the Plumbing Official.

B. Piping Tests:

1. General: Provide temporary equipment for testing, including pump and gauges. Test piping system before insulation is installed wherever feasible. Test each natural section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.
2. Test piping that is to be concealed before being permanently enclosed.
3. As soon as work has been completed, conduct preliminary tests to ascertain compliance with specified requirements. Make repairs or replacements as required.
4. Give a minimum of twenty-four (24) hours notice to Engineer of dates when acceptance test will be conducted. Conduct tests as specified for each system in presence of representative of Agency Having Jurisdiction or his representative. Submit three (3) copies of successful tests to the Engineer for his review. Report shall state system tested and date of successful test.
5. Obtain certificates of approval, acceptance and compliance with regulations of Agencies Having Jurisdiction. Work shall not be considered complete until such certificates have been delivered.
6. All costs involved in these tests shall be borne by Contractor.
7. System Tests:

a. Hydrostatic Test: Pressurize the system to 100psig or 150 percent of system pressure, whichever is greater. Maintain pressure until the entire system has been inspected for leaks, but in no case for a time period of less than four (4) hours.
b. Compressed Air or Nitrogen Test: Compressed air tests may be substituted for hydrostatic tests only when ambient conditions prohibit safe use of hydrostatic testing and must be reviewed by the Engineer prior to any testing. For tests of this type, subject the piping system to the gas pressure indicated for that specific system. Maintain the test pressure for the duration of a soapy water test of each joint. The air test is not allowed on CPVC piping systems.
c. Repair failed piping sections by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
d. Drain test water from piping systems after testing and repair work has been completed.

3.6 ADJUSTING AND CLEANING

A. Clean and disinfect water distribution piping as follows:

1. Purge all new water distribution piping systems and parts of existing systems, which have been altered, extended, or repaired prior to use. Clean and replace strainers.
2. Use the purging and disinfecting procedure prescribed by the Authority Having Jurisdiction, or in case a method is not prescribed by that authority, the procedure described in either AWWA C651, or AWWA C652, or as described below:

    a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
    b. Fill the system or part thereof, with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system, or part thereof, and allow to stand for twenty-four (24) hours or fill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for three (3) hours.
    c. Following the allowed standing time, flush the system with clean potable water until chlorine does not remain in the water coming from the system.
    d. Submit water samples in sterile bottles to the Authority Having Jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.

B. Prepare reports for all purging and disinfecting activities.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This Section includes potable cold, hot, and recirculated hot water specialties within the building to a point 5-feet outside the building. This section includes the following:

1. Piping Specialties:

a. Water Hammer Arrestors
b. Hose Bibbs
c. Wall and Yard Hydrants
d. Thermostatic Mixing Valves

1.2 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following:

1. Local Plumbing Code and Utility Department requirements.
2. NSF 61 Compliance: Drinking Water System Components – Health Effects; Sections 1 through 9 and Annex G.
3. Safe Drinking Water Act – Public Law No. 111-380.
4. Colorado Cross Connection Control Manual.
5. NSF/ANSI 372: Drinking Water System Components, Lead Content

B. All piping systems shall be installed to manufacturer's standards and in accordance with the pipe manufacturer's instructions. Contractor shall demonstrate prior to installation of any piping that joining methods and procedures are acceptable to the Engineer and/or Owner with the Factory Representative present. During the installation of the piping system, the Contractor shall be required to provide joint coupons as requested by the Owner or Engineer and repair and/or replace system if joints are deemed unsatisfactory.

1.3 INSTALLER'S QUALIFICATIONS

A. All Plumbing Work shall be performed by a State of Colorado Licensed Contractor under the supervision of a Licensed Plumber. Contractors shall verify that plumbers are currently licensed by the State of Colorado and shall supply the Project Manager or names and license numbers. Contractors shall have a minimum of three (3) years of satisfactory performance in conducting the type of work specified.

1.4 SUBMITTALS

A. Submit under provisions of Division 1.

1.5 CLOSEOUT SUBMITTALS

A. Submit under provisions of Division 1.

B. Test Reports.

C. Valve schedule listing valve designation number, valve type, size, location, and function of all valves.

D. Backflow Preventer State Certification Test.

PART 2 - PRODUCTS

2.1 PIPING SPECIALTIES

A. Water Hammer Arresters:

1. Piston type, with copper/brass casing and piston, pressure rated for 250 PSI, tested and certified in accordance with ASSE 1010 and NSF 372. Water hammer arrestor shall be designed to provide continuous protection, without maintenance, against excessive surge pressure. Size according to the following schedule.
2. Where water hammer arresters are installed, provide isolation valve on the branch to the arrester and an access panel.
3. Single or multiple fixture locations will not need an isolation valve and access panel if prior approval is first obtained by the authority having jurisdiction and owner.
4. Units shall be sized in accordance with the following table:

Drawing Designation	Fixture Unit Rating	P.D.I. Size	Connection Size
SA-1	1-11	A	1/2"
SA-2	12-32	B	3/4"
SA-3	33-60	C	1"
SA-4	61-113	D	1"
SA-5	114-154	E	1"
SA-6	155-330	F	1"

5. Acceptable Manufacturers:

   a. Precision Plumbing Products
   b. Sioux Chief
   c. Jay R. Smith

B. Hose Bibbs:

1. Finished Rooms with Floor Drains: Polished chrome plated bronze body, with renewable composition disc, removable handle, 3/4-inch NPT inlet, vacuum breaker, 3/4-inch hose outlet.

   a. Acceptable Manufacturers:

      1) Chicago Faucet No. 952-CP
      2) Woodford
      3) T&S Brass
      4) Zurn
      5) Prier

C. Wall and Yard Hydrants:

1. Flush with wall, non-freeze, box type, wall hydrant; all brass with nickel bronze box cover and frame, "T" handle loose key, key lock cover, two (2) check valves, ASSE 1052 or 1019 approved, self draining body and shank, 3/4-inch male hose thread outlet, 3/4-inch male or female I.P.S. thread inlet, renewable seat; shank length to extend through primary exterior wall surface sufficient distance to prevent freezing.

   a. Acceptable Manufacturers:

      1) Woodford Model B67
      2) Josam
      3) Wade
      4) Prier

D. Thermostatic Mixing Valves:

1. Exposed type, all lead-free brass or bronze thermostatically controlled mixing valve with stainless steel piston, fail safe automatic shut-down if either hot or cold water pressure fails; union connection, integral check valves rough chrome finish. Valve shall be ASSE rated for the application. Valve shall be to meet the lead-free requirements of NSF 61 and NSF 372.

   a. Acceptable Manufacturers:

      1) Powers
      2) Leonard
      3) Symmons
      4) Lawler

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Water Hammer Arresters:

1. Install water hammer arresters with isolation valve in accessible location.
2. Provide access doors located in accordance with architectural recommendations.
3. Water hammer arresters shall be installed at all quick-closing valve locations, at each set of flush valves and where hydrostatic shock pressures could occur.

B. Install mixing valves with integral check valves or in-line check valves, unions and isolation valves.

3.2 FIELD QUALITY CONTROL

A. Inspections: Inspect water distribution piping as follows:

1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the Authority Having Jurisdiction.
2. During the progress of the installation, notify the Plumbing Official Having Jurisdiction, at least forty-eight (48) hours prior to the time such inspection must be made. Perform tests specified below in the presence of the Plumbing Official.

    a. Rough-In Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
    b. Final Inspection: Arrange for a final inspection by the Plumbing Official to observe the tests specified below and to insure compliance with the requirements of the Plumbing Code.

3. Reinspections: Whenever the Plumbing Official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the Plumbing Official.
4. Reports: Prepare inspection reports, signed by the Plumbing Official.

3.3 ADJUSTING AND CLEANING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE & VENT PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This Section specifies the following:

1. Pipe and Tube Materials:

a. Sanitary Drainage, Vents
b. Sump Pump Discharge
c. Equipment Drains and Overflows

1.2 DEFINITIONS

A. Building Drain: That part of the lowest piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer to a point 5'-0" outside the building wall.

B. Building Sewer: That part of the horizontal piping of a drainage system which extends from the end of the building drain and conveys its discharge to a public sewer, private sewer, individual sewage disposal system, or other point of disposal.

C. Drainage System: Includes all the piping within a public or private premises which conveys sewage, rain water or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.

D. Vent System: Pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and back pressure.

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

1.4 CLOSEOUT SUBMITTALS

A. Submit under provisions of Division 1.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following:

1. Plumbing Code Compliance: Comply with applicable portions of the International Plumbing Code.
2. ANSI Compliance: Comply with applicable ANSI standards pertaining to materials, products, and installation of soil and waste systems.
3. ASSE Compliance: Comply with applicable ASSE standards pertaining to materials, products, and installation of soil and waste systems.
4. ASTM Compliance: Comply with applicable ASTM Standards pertaining to materials, products, and installation of soil and waste systems.
5. CISPI Compliance: Comply with applicable CISPI Standards pertaining to materials, products, and installation of soil and waste systems.
6. PDI Compliance: Comply with applicable PDI standards pertaining to products and installation of soil and waste systems.
7. PVC, PP and ABS Pipe: Only Contractor's personnel which have received training in the installation of this material and meet the manufacturer's qualifications shall do the assembly of such material.

PART 2 - PRODUCTS

2.1 SANITARY DRAINAGE AND VENTS

A. Above Grade:

1. Pipe 1-1/2 Inch to 10-Inch: Service class hubless cast iron soil pipe: CISPI 301, ASTM A888. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be listed by NSF International.

    a. Fittings: CISPI 301, NSF International, hubless cast iron, long sweep bends.
    b. Joining Material: For ASTM A888 pipe, CISPI 310 coupling, assembly of stainless steel shield and clamp with ASTM C564 elastomeric sealing sleeve. Coupling shall be certified by NSF for CISPI 310 testing and manufactured in the USA.

2. Pipe 1-1/4 Inch to 4-Inch: DWV Copper Tube: ASTM B 306.

    a. Fittings:

        1) Cast Copper Solder-Joint Drainage Fittings: ASME B16.23.
        2) Wrought Copper Solder-Joint Drainage Fittings: ASME B16.29.

    b. Joining Material:

        1) Solder: Lead-free ASTM B32, Solder shall be certified to meet NSF 61 Annex G and/or NSF 372.

    c. Fluxes:

        1) Lead-free ASTM B813 liquid or paste type.

3. Manufacturers (Cast Iron Pipe):

   a. Tyler Pipe
   b. AB&I
   c. Charlotte Pipe & Foundry

B. Below Grade:

1. Pipe 2-Inch to 15-Inch: Service class cast iron hub-and-spigot soil pipe, ASTM A74. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be listed by NSF International.

   a. Fittings: ASTM A74 cast iron service class, hub and spigot compression joint, long sweep bends.
   b. Neoprene Compression Gaskets: ASTM C564.

2. Pipe 2-Inch to 16-Inch: Iron Pipe Size (IPS) Polyvinyl Chloride (PVC) Solid Wall Schedule 40 DWV.

   a. Manufactured from virgin Type 1, Grade 1 PVC 1120 (Cell Class 12454-B) per ASTM D-1784.
   b. Meet the dimensional, physical properties, and tolerances of ASTM D-1785 and ASTM D-2665.
   c. Mark pipe with ASTM D-2665, nominal pipe size, and the symbols PVC and DWV at 5-foot intervals.
   d. Fittings: ASTM D2665, PVC, solvent cement with long sweep bends. Injection molded conforming to National Sanitation Standard 14.
   e. Joining Material:

      1) Solvent cement suitable for type and size of pipe installed as recommended by the pipe manufacturer.
      2) Make solvent cement joints from a two-step process with ASTM F656 primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM D-2564.

3. Manufacturers (Cast Iron Pipe):

   a. Tyler Pipe
   b. AB&I
   c. Charlotte Pipe & Foundry

2.2 SUMP PUMP DISCHARGE

A. Above Grade - Inside Buildings:

1. Pipe 4-Inch and Smaller: ASTM B 88; Type L hard drawn copper tube.

   a. Fittings:

      1) Wrought Copper Solder-Joint Fittings: ASME B16.22.

2) Cast Copper Solder-Joint Fittings: ASME B16.18
3) Cast Copper Alloy Flanges, Class 150 and 300, Flat-Face Type: ASME B16.24

b. Joining Material:

1) Solder: Lead-free, ASTM B32, Solder shall be certified to meet NSF 61 Annex G and/or NSF 372.

c. Fluxes:

1) Lead-free, ASTM B813.

B. Gate Valve:

1. 2-1/2 Inch and Smaller: MSS-SP-80, Class 150 rising stem, union bonnet, solid wedge, bonnet and wedge are to be of bronze ASTM B-62. Stems shall be silicon bronze ASTM B-371 or low-zinc alloy B-99, non-asbestos packing and malleable ductile iron hand wheel. Soldered end connections.

a. Acceptable Manufacturers:

1) Nibco S 134
2) Milwaukee
3) Hammond

2. 3-Inch and Larger: MSS-SP70, Class 125 OS&Y, bolted bonnet, ASTM A126 Class B cast iron body and bonnet, bronze trimmed, non-asbestos packing and gaskets, and cast iron hand wheel. Flanged end connections.

a. Acceptable Manufacturers:

1) Nibco F617-0
2) Milwaukee
3) Hammond

C. Swing Check Valve:

1. 2-1/2 Inch and Smaller: MSS SP-80; Class 150 SWP, ASTM B-62 bronze body and bonnet, horizontal swing design, Y-pattern, with bronze seat disk. Threaded or soldered end connections.

a. Acceptable Manufacturers:

1) Nibco T/S433 - B
2) Milwaukee
3) Hammond

2. 3-Inch and Larger: MSS SP-71; Class 125, ASTM A126 Class B cast iron body with bronze trim, non-asbestos gasket, horizontal swing, and flanged ends.

a. Acceptable Manufacturers:

1) Nibco F918-B
2) Milwaukee
3) Hammond

2.3 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Pipe and Fittings:

1. DWV Copper Tube: ASTM B 306.
2. Fittings:

a. Cast Copper Solder-Joint Drainage Fittings: ASME B16.23.
b. Wrought Copper Solder-Joint Drainage Fittings: ASME B16.29.

3. Joining Material:

a. Solder: Lead-free, ASTM B32, Solder shall be certified to meet NSF 61 Annex G and/or NSF 372.

4. Fluxes:

a. Lead-free, ASTM B813.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Install piping in accordance with Authorities Having Jurisdiction, except where more stringent requirements are indicated.

B. Inspect piping before installation to detect apparent defects. Mark defective materials with white paint and promptly remove from site.

C. Verify all dimensions by field measurements. Verify that all drainage and vent piping and specialties may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

D. Verify all existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.

E. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.

F. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.

G. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PIPING INSTALLATION

A. Install plumbing drainage piping with 1/4-inch per foot (2 percent) downward slope in direction of drain for piping 3-inch and smaller, and 1/8-inch per foot (1 percent) for piping 4-inch and larger.

B. Install 1-inch thick extruded polystyrene over underground drainage piping above frost line and not under building. Provide width to extend minimum of 12-inch beyond each side of pipe. Install directly over pipe, centered on pipe centerline.

C. Provide thrust restraints consisting of bracing to structure and rodded joints at branches and changes in direction for cast iron pipe 5-inches and larger suspended within the building and for all changes in diameter greater than two pipe sizes IPC 308.7.1.

D. Provide sway bracing to prevent shear at joints on cast iron piping suspended in excess of 18-inches on single rod hangers.

E. Provide rigid support sway bracing at all changes in direction greater than 45 degrees for all suspended cast iron piping for pipe sizes 4-inch and larger IPC 308.6.

F. Suspended PVC piping shall be installed using the same requirements as cast iron piping for thrust and sway bracing as indicated in the articles above. Hanger spacing shall be as recommended by the manufacturer and code.

G. Install underground cast iron drain piping to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. PVC piping shall be installed in accordance with ASTM D 2321 and the plumbing code.

H. Lay piping beginning at low point of system, true to grades and alignment indicated, with unbroken continuity of invert.

I. Place bell ends or groove ends of piping facing upstream.

J. Install gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.

K. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.

L. Remove unstable, soft, and unsuitable materials at the surface upon which pipes shall be laid, and backfill with clean sand or pea gravel to indicated invert elevation.

M. Shape bottom of trench to fit the bottom 1/4 of the circumference of pipe. Fill unevenness with tamped sand. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation.

N. Minimum size of waste and vent piping installed under floor slab on grade shall be 2-inches.

O. Vent termination shall be a minimum 12 - inches above finished roof. Vent termination shall terminate per IPC Chapter 9, Section 904.1.

3.3 SERVICE CONNECTIONS

A. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

3.4 CONNECTIONS

A. Piping Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the Plumbing Code.

B. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.5 FIELD QUALITY CONTROL

A. Inspections:

1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the Authority Having Jurisdiction.
2. During the progress of the installation, notify the Plumbing Official Having Jurisdiction, at least forty-eight (48) hours prior to the time such inspection must be made. Perform tests specified below in the presence of the Plumbing Official.

    a. Rough-In Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
    b. Final Inspection: Arrange for a final inspection to observe the tests specified and to insure compliance with the requirements of the Plumbing Code.

3. Re-Inspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for re-inspection.
4. Reports: Prepare inspection reports, signed by the Plumbing Official.

B. Piping System Test: Test drainage and vent system in accordance with the procedures of the Authority Having Jurisdiction, or in the absence of a published procedure, as follows.

1. Subject all waste and vent piping, including building drain, and building sewer to a water test.
2. Tightly close all openings in the piping system except the highest opening, and fill the system with water to the point of overflow.
3. Maintain water in the system, or in the portion under test, for at least fifteen (15) minutes before inspection starts; the system shall then be tight to all points. No section shall be tested with less than a 10-foot head of water.

3.6 ADJUSTING AND CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Clean drain strainers, domes, and traps. Remove dirt and debris.

3.7 PROTECTION

A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or whenever work stops. Piping shall not be left open ended during construction.

C. Exposed ABS or PVC Piping: Protect plumbing vents exposed to sunlight with two (2) coats of water-based latex paint. Color selected by Architect.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This Section specifies the following:

1. Drainage Piping Specialties:

a. Trap Primers
b. Cleanouts
c. Floor Drains
d. Floor Sinks
e. Pre-cast Concrete Basins and Manholes

1.2 DEFINITIONS

A. Building Drain: That part of the lowest piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer to a point 5'-0" outside the building wall.

B. Building Sewer: That part of the horizontal piping of a drainage system which extends from the end of the building drain and conveys its discharge to a public sewer, private sewer, individual sewage disposal system, or other point of disposal.

C. Drainage System: Includes all the piping within a public or private premises which conveys sewage, rain water or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.

D. Vent System: Pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and back pressure.

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

1.4 CLOSEOUT SUBMITTALS

A. Submit under provisions of Division 1.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following:

1. Plumbing Code Compliance: Comply with applicable portions of the International Plumbing Code.
2. ANSI Compliance: Comply with applicable ANSI standards pertaining to materials, products, and installation of soil and waste systems.
3. ASSE Compliance: Comply with applicable ASSE standards pertaining to materials, products, and installation of soil and waste systems.
4. ASTM Compliance: Comply with applicable ASTM Standards pertaining to materials, products, and installation of soil and waste systems.
5. CISPI Compliance: Comply with applicable CISPI Standards pertaining to materials, products, and installation of soil and waste systems.
6. PDI Compliance: Comply with applicable PDI standards pertaining to products and installation of soil and waste systems.
7. PVC, PP and ABS Pipe: Only Contractor's personnel which have received training in the installation of this material and meet the manufacturer's qualifications shall do the assembly of such material.

PART 2 - PRODUCTS

2.1 DRAINAGE PIPING SPECIALTIES

A. Acceptable Manufacturers:

1. Josam Mfg. Co.
2. Smith (Jay R.) Mfg. Co.
3. Tyler Pipe; Subs. of Tyler Corp.
4. Zurn Industries Inc; Hydromechanics Division
5. Wade
6. Woodford
7. Precision Plumbing Products
8. Watts

B. Trap Primers:

1. Pressure Drop Type:

a. Bronze body valve with automatic vacuum breaker, with 1/2-inch connections matching piping system. Complying with ASSE 1018.
b. Adjustable to high or low pressure and automatically activated whenever any faucet is opened in the building, causing a pressure drop.
c. Connections: Inlet 1/2-inch male NPT; Outlet 1/2-inch female NPT.
d. P1-500 (1 – 4 floor drains)/P2-500 (1 – 2 floor drains) Trap Primer Valve by Precision Plumbing Products, Inc., or equal.
e. When more than one (1) trap is to be primed, provide multiple distribution units, as required for application, by the manufacturer.
f. Provide access panel or locate unit so accessible.

2. Electronic Type:

a. Bronze body valve with vacuum breaker, with 1/2 – inch connections matching piping system. Complying with ASSE 1044 and UL listed.
b. Unit shall have electronic solenoid valve operation, recycle timer box with pre-set timer that opens once for 10 seconds every 24 hours, 6-foot solenoid cord.
c. Connections: Inlet 1/2-inch male NPT; Outlet 1/2-inch female NPT.
d. MP-500-115V Trap Primer Valve by Precision Plumbing Products, Inc., or equal.
e. When more than one (1) trap is to be primed, provide multiple distribution units, as required for application, by the manufacturer.

3. Trap Seal Units

a. Trap seal unit fits 2 to 4-inch floors drains. Installation shall not require special tools or silicon sealant. Listed to the requirements of ASSE 1072, manufactured by sure seal company – Rectorseal.

C. Cleanouts:

1. Cleanout Plugs: ASTM A74, Cast brass, threads complying with ANSI B2.1, and Local Plumbing Code.
2. Floor Cleanout: Round, cast iron body with recessed bronze closure plug; scoriated polished bronze frame and cover plate.
3. Wall Cleanout: Cleanout tee with raised head brass plug tapped for 1/4-20 thread; flat style chrome plated wall cover plate with holes for 1/4-inch bolt; 1/4-20 threaded bolt with chrome plated flat head.
4. Grade Cleanout or Interior Locations Subject to Vehicle Traffic: Round cast iron flanged housing with heavy duty ductile iron cover. Set in 36-inch square concrete pad. Available in pipe sizes 2-inch to 6-inch. Josam No. 58680-5.
5. Line Cleanout: Cast iron tapped cleanout ferrule with raised head brass plug.
6. Access Panels: Fire rated assembly compatible with wall rating.

D. Floor Drains:

1. Refer To Plumbing Fixture Schedule On Drawings

E. Floor Sinks:

1. Refer To Plumbing Fixture Schedule On Drawings

2.2 PRE-CAST CONCRETE BASINS AND MANHOLES

A. Acceptable Manufacturers: Subject to compliance with requirements, provide drainage and vent systems from one of the following:

1. Copeland
2. Front Range Precast Concrete, Inc.

3. Amcor Precast (Colorado Division of Oldcastle Precast, Inc.)

B. Manholes:

1. Constructed from pre-cast concrete sections with heavy-duty cast iron traffic cover and rim. All concrete, reinforcing, steps and sealant shall meet or exceed ASTM C478.
2. Base: Preformed base set on approved bedding material. Refer to Division 1 for compaction requirements. At a minimum compaction shall be to a minimum 90% proctor. Where heavy density concrete is poured in place, a wait time of at least forty-eight (48) hours is required prior to setting the pre-cast sections.
3. Flow Channels: Formed in cement mortar on the base to provide smooth flow and maintain the sewer grade; troweled smooth.
4. Bottom Manhole Section: Set bottom manhole section on base utilizing butyl gasket. Set each additional riser or cone section utilizing a tongue and groove system with butyl gasket in same manner. All joints, holes and imperfections shall be sealed with non-shrink grout.
5. Pipe Connections: Follow manufacturer's recommendations for connections.
6. Manhole Cover: Install with cast iron receiving frame and adjustable rings so that it is flush with pavement or grade. The cover shall be suitable for A.A.S.H.O. H-20 wheel loading.
7. Steps: Meet or exceed ASTM C478 and OSHA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Install piping in accordance with Authorities Having Jurisdiction, except where more stringent requirements are indicated.

B. Inspect piping before installation to detect apparent defects. Mark defective materials with white paint and promptly remove from site.

C. Verify all dimensions by field measurements. Verify that all drainage and vent piping and specialties may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

D. Verify all existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.

E. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.

F. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.

G. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF PIPING SPECIALTIES

A. Provide flashing for all floor drains, floor cleanouts and shower drains above grade. Make watertight with Chloraloy 240 underslab moisture vapor barrier as manufactured by the Nobel Co. of Grand Haven, Michigan. Extend flashing at least 24-inch from drain rim into floor membrane or on structural floor. Fasten flashing to drain clamp device and make watertight, durable joint. Provide flashing collar extension with all drains and cleanouts installed above grade.

B. Backwater Valves: Install in sanitary building drain piping as indicated, and as required by the Plumbing Code. For shallow interior installations, provide minimum 13-inch diameter cleanout cover flush to floor centered over backwater valve cover and of adequate size to remove valve cover for service. For deeper installations, provide manhole with steps and gas-tight cover and ring.

C. Cleanouts: Lubricate plugs with mixture of graphite and linseed oil. Prior to building turnover remove cleanout plugs, re-lubricate and reinstall using only enough force to ensure permanent leakproof joint.

1. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:

    a. As required by Plumbing Code;
    b. At each change in direction of piping greater than 45 degrees below slab;
    c. At minimum intervals of 50-feet;
    d. At base of each vertical soil or waste stack;
    e. At sinks and urinals on grade;
    f. At each upper terminal;
    g. At egress of building (surface cleanout).
    h. At each water closet or toilet group.

2. Cleanout Covers: Install floor and wall cleanout covers for concealed piping, types as indicated, and in accessible locations.
3. Access Panels: Where cleanouts are located at a fire rated wall, provide and install fire-rated access panels to maintain wall rating. Provide panel sized to allow access to the cleanout.

D. Floor Drains:

1. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor.
2. Trap all drains connected to the sanitary sewer with minimum trap size that of drain connected.
3. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
4. Position drains so that they are accessible and easy to maintain.
5. Provide with P-trap the same size as the floor drain unless otherwise noted on Mechanical Drawings.
6. Provide flashing membrane for all floor drains in structure above slab on grade level.

E. Trap Primers: Install trap primers with piping pitched towards drain trap, minimum of 1/8-inch per foot (1 percent). Adjust trap primer for proper flow. Trap primer piping shall be continuous (no joints) below grade and insulated with 1/2-inch Armaflex insulation. Where a joint below grade is required, such joint shall be brazed.

3.3 SERVICE CONNECTIONS

A. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

3.4 FIELD QUALITY CONTROL

A. Inspections:

1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the Authority Having Jurisdiction.
2. During the progress of the installation, notify the Plumbing Official Having Jurisdiction, at least forty-eight (48) hours prior to the time such inspection must be made. Perform tests specified below in the presence of the Plumbing Official.

    a. Rough-In Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
    b. Final Inspection: Arrange for a final inspection to observe the tests specified and to insure compliance with the requirements of the Plumbing Code.

3. Re-Inspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for re-inspection.
4. Reports: Prepare inspection reports, signed by the Plumbing Official.

B. Piping System Test: Test drainage and vent system in accordance with the procedures of the Authority Having Jurisdiction, or in the absence of a published procedure, as follows.

1. Subject all waste and vent piping, including building drain, roof drain and building sewer to a water test.
2. Tightly close all openings in the piping system except the highest opening, and fill the system with water to the point of overflow.
3. Maintain water in the system, or in the portion under test, for at least fifteen (15) minutes before inspection starts; the system shall then be tight to all points. No section shall be tested with less than a 10-foot head of water.

3.5 ADJUSTING AND CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Clean drain strainers, domes, and traps. Remove dirt and debris.

C. Rod all new piping to ensure there are not blockages or debris in piping. Rod existing mains where new piping connects to a point 5 feet outside the building**.**

3.6 PROTECTION

A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or whenever work stops. Piping shall not be left open ended during construction.

END OF SECTION 221319

SECTION 221413 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This Section specifies the following:

1. Pipe and Tube Materials:

a. Roof Drainage

2. Drainage Piping Specialties:

a. Cleanouts
b. Area Drains
c. Roof Drains

1.2 DEFINITIONS

A. Drainage System: Includes all the piping within a public or private premises which conveys rain water to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

1.4 CLOSEOUT SUBMITTALS

A. Submit under provisions of Division 1.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following:

1. Plumbing Code Compliance: Comply with applicable portions of International Plumbing Code.
2. ANSI Compliance: Comply with applicable ANSI standards pertaining to materials, products, and installation of soil and waste systems.
3. ASSE Compliance: Comply with applicable ASSE standards pertaining to materials, products, and installation of soil and waste systems.
4. ASTM Compliance: Comply with applicable ASTM Standards pertaining to materials, products, and installation of soil and waste systems.
5. CISPI Compliance: Comply with applicable CISPI Standards pertaining to materials, products, and installation of soil and waste systems.
6. PDI Compliance: Comply with applicable PDI standards pertaining to products and installation of soil and waste systems.

7. PVC, PP and ABS Pipe: Only Contractor's personnel which have received training in the installation of this material and meet the manufacturer's qualifications shall do the assembly of such material.

PART 2 - PRODUCTS

2.1 ROOF DRAINAGE

A. Above Grade – 30 Feet of Head or Less:

1. Pipe 1-1/2 Inch to 10-Inch: Service class hubless cast iron soil pipe: CISPI 301, ASTM A888.

a. Fittings: CISPI 301, hubless cast iron, long sweep bends.
b. Joining Material: For ASTM A888 pipe, CISPI 310 coupling, assembly of stainless steel shield and clamp with ASTM C564 elastomeric sealing sleeve. Coupling shall be certified by NSF for CISPI 310 testing and manufactured in USA.

2. Manufacturers (Cast Iron Pipe):

a. Tyler Pipe
b. AB&I
c. Charlotte Pipe & Foundry

B. Below Grade:

1. Pipe 2-Inch to 15-Inch: Service class cast iron hub-and-spigot soil pipe, ASTM A74.

a. Fittings: ASTM A74 service class cast iron, hub and spigot compression joint, long sweep bends.
b. Neoprene Compression Gaskets: ASTM C564.

2. Manufacturers (Cast Iron Pipe):

a. Tyler Pipe
b. AB&I
c. Charlotte Pipe & Foundry

3. Pipe 2-Inch to 16-Inch: Iron Pipe Size (IPS) Polyvinyl Chloride (PVC) Solid Wal Schedule 40 DWV.

a. Manufactured from virgin Type 1, Grade 1 PVC 1120 (Cell Class 12454-B) per ASTM D-1784.
b. Meet the dimensional, physical properties, and tolerances of ASTM D-1785 and ASTM D-2665.
c. Mark pipe with ASTM D-2665, nominal pipe size, and the symbols PVC and DWV at 5-foot intervals.

d. Fittings: ASTM D2665, PVC, solvent cement with long sweep bends. Injection molded conforming to National Sanitation Standard 14.

e. Joining Material:

1) Solvent cement suitable for type and size of pipe installed as recommended by the pipe manufacturer.

2) Make solvent cement joints from a two-step process with ASTM F656 primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM D-2564.

2.2 SUMP PUMP DISCHARGE

A. Above Grade - Inside Buildings:

1. Pipe 4-Inch and Smaller: ASTM B 88; Type L hard drawn copper tube.

a. Fittings:

1) Wrought Copper Solder-Joint Fittings: ASME B16.22.
2) Cast Copper Solder-Joint Fittings: ASME B16.18
3) Cast Copper Alloy Flanges, Class 150 and 300, Flat-Face Type: ASME B16.24

b. Joining Material:

1) Solder: Lead-free, ASTM B32, Solder shall be certified to meet NSF 61 Annex G and/or NSF 372

c. Fluxes:

1) Lead-free, ASTM B813, liquid or paste type.

B. Gate Valve:

1. 2-1/2 Inch and Smaller: MSS-SP-80, Class 150 rising stem, union bonnet, solid wedge, bonnet and wedge are to be of bronze ASTM B-62. Stems shall be silicon bronze ASTM B-371 or low-zinc alloy B-99, non-asbestos packing and malleable ductile iron hand wheel. Soldered end connections.

a. Acceptable Manufacturers:

1) Nibco S 134
2) Milwaukee
3) Hammond

2. 3-Inch and Larger: MSS-SP70, Class 125 OS&Y, bolted bonnet, ASTM A126 Class B cast iron body and bonnet, bronze trimmed, non-asbestos packing and gaskets, and cast iron hand wheel. Flanged end connections.

a. Acceptable Manufacturers:

1) Nibco F617-0
2) Milwaukee

3) Hammond

C. Swing Check Valve:

1. 2-1/2 Inch and Smaller: MSS SP-80; Class 150 SWP, ASTM B-62 bronze body and bonnet, horizontal swing design, Y-pattern, with bronze seat disk. Threaded or soldered end connections.

a. Acceptable Manufacturers:

1) Nibco T/S433- B
2) Milwaukee
3) Hammond

2. 3-Inch and Larger: MSS SP-71; Class 125, ASTM A126 Class B cast iron body with bronze trim, non-asbestos gasket, horizontal swing, and flanged ends.

a. Acceptable Manufacturers:

1) Nibco F918-B
2) Milwaukee
3) Hammond

2.3 DRAINAGE PIPING SPECIALTIES

A. Acceptable Manufacturers:

1. Josam Mfg. Co.
2. Smith (Jay R.) Mfg. Co.
3. Tyler Pipe; Subs. of Tyler Corp.
4. Zurn Industries Inc; Hydromechanics Division
5. Wade
6. Woodford
7. Precision Plumbing Products
8. Watts

B. Cleanouts:

1. Cleanout Plugs: ASTM A74, Cast brass, threads complying with ANSI B2.1, and Local Plumbing Code.
2. Floor Cleanout: Round, cast iron body with recessed bronze closure plug; scoriated polished bronze frame and cover plate.
3. Wall Cleanout: Cleanout tee with raised head brass plug tapped for 1/4-20 thread; flat style chrome plated wall cover plate with holes for 1/4-inch bolt; 1/4-20 threaded bolt with chrome plated flat head or provide fire rated access panel/assembly compatible with the wall rating.
4. Grade Cleanout or Interior Locations Subject to Vehicle Traffic: Round cast iron flanged housing with heavy duty cast iron cover. Set in 36-inch square concrete pad. Available in pipe sizes 2-inch to 6-inch. Jay R Smith No. 4260 series
5. Line Cleanout: Cast iron tapped cleanout ferrule with raised head brass plug.

C. Area Drains:

1. Refer To Plumbing Fixture Schedule On Drawings

D. Roof Drains:

1. Cast iron body with sump, removable cast iron vandal-proof dome strainer, cast iron flashing flange and cast iron ring with integral gravel stop, underdeck clamp, sump receiver for locations where roof drain is not cast in place, no-hub bottom outlet.

a. Jay R. Smith Fig. 1010

2. Overflow Drain: Cast iron body with sump, removable cast iron vandal-proof dome strainer, cast iron flashing flange and cast iron clamp with integral gravel stop, cast iron underdeck clamp, sump receiver for location where roof drain is not cast in place, no-hub bottom outlet, 2-inch high cast iron water dam standpipe under dome strainer.

a. Jay R. Smith Fig. 1070

3. Down Spout Nozzle: Cast bronze body and flange.

a. Jay R. Smith Fig. 1770

2.4 PRE-CAST CONCRETE BASINS AND MANHOLES

A. Acceptable Manufacturers: Subject to compliance with requirements, provide drainage and vent systems from one of the following:

1. Copeland
2. Front Range Precast Concrete, Inc.
3. Amcor Precast (Colorado Division of Oldcastle Precast, Inc)

B. Light or Medium Duty Basin with Grate:

1. Round, reinforced, one-piece, pre-cast concrete with solid bottom and top opening for grate; **[ ]**-inch inside diameter with medium duty **[ ]**-inch cast iron grate, top of grate to be flush with top of basin; bottom of basin to be 12-inches below invert of outlet pipe; provide hole in basin wall for outlet pipe; see Mechanical Plans for outlet pipe size and elevation of outlet and top of grate.

C. Manholes:

1. Constructed from pre-cast concrete sections with heavy-duty cast iron traffic cover and rim. All concrete, reinforcing, steps and sealant shall meet or exceed ASTM C478.
2. Base: Preformed base set on approved bedding material. Refer to Division 1 for compaction requirements. At a minimum compaction shall be to a minimum 90% proctor. Where heavy density concrete is poured in place, a wait time of at least forty-eight (48) hours is required prior to setting the pre-cast sections.

3. Flow Channels: Formed in cement mortar on the base to provide smooth flow and maintain the sewer grade; troweled smooth.
4. Bottom Manhole Section: Set bottom manhole section on base utilizing rubber gaskets and/or preformed mastic or butyl gaskets to seal the joints. Set each additional riser or cone section utilizing a tongue and groove system with butyl gasket in same manner. All joints, holes and imperfections shall be sealed with non-shrink grout.
5. Pipe Connections: Follow manufacturer's recommendations for connections.
6. Manhole Cover: Install with cast iron receiving frame and adjustable rings so that it is flush with pavement or grade. The cover shall be suitable for A.A.S.H.O. H-20 wheel loading.
7. Steps: Meet or exceed ASTM C478 and OSHA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Install piping in accordance with Authorities Having Jurisdiction, except where more stringent requirements are indicated.

B. Inspect piping before installation to detect apparent defects. Mark defective materials with white paint and promptly remove from site.

C. Verify all dimensions by field measurements. Verify that all drainage piping and specialties may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

D. Verify all existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.

E. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.

F. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PIPING INSTALLATION

A. Install plumbing drainage piping with 1/4-inch per foot (2 percent) downward slope in direction of drain for piping 3-inch and smaller, and 1/8-inch per foot (1 percent) for piping 4-inch and larger.

B. Install 1-inch thick extruded polystyrene over underground drainage piping above frost line and not under building. Provide width to extend minimum of 12-inch beyond each side of pipe. Install directly over pipe, centered on pipe centerline.

C. Provide thrust restraints consisting of bracing to structure and rodded joints at branches and changes in direction for cast iron pipe 5-inches and larger suspended within the building and for all changes in diameter greater than two pipe sizes IPC 308.7.1.

D. Provide sway bracing to prevent shear at joints on cast iron piping suspended in excess of 18-inches on single rod hangers.

E. Provide rigid support sway bracing at all changes in direction greater than 45 degrees for all suspended cast iron piping for pipe sizes 4-inch and larger IPC 308.6.

F. Suspended PVC piping shall be installed using the same requirements as cast iron piping for thrust and sway bracing as indicated in the articles above. Hanger spacing shall be as recommended by the manufacturer and code.

G. Install underground cast iron drain piping to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual PVC piping shall be installed in accordance with ASTM 2321 and the plumbing code.

H. Lay piping beginning at low point of system, true to grades and alignment indicated, with unbroken continuity of invert.

I. Place bell ends or groove ends of piping facing upstream.

J. Install gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.

K. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.

L. Remove unstable, soft, and unsuitable materials at the surface upon which pipes shall be laid, and backfill with clean sand or pea gravel to indicated invert elevation.

M. Shape bottom of trench to fit the bottom 1/4 of the circumference of pipe. Fill unevenness with tamped sand. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation.

3.3 INSTALLATION OF PIPING SPECIALTIES

A. Cleanouts: Lubricate plugs with mixture of graphite and linseed oil. Prior to building turnover remove cleanout plugs, re-lubricate and reinstall using only enough force to ensure permanent leakproof joint.

1. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:

   a. As required by Plumbing Code;
   b. At each change in direction of piping greater than 45 degrees below slab;
   c. At minimum intervals of 50-feet;
   d. At base of each vertical soil or waste stack;
   e. At egress of building (surface cleanout).

2. Cleanout Covers: Install floor and wall cleanout covers for concealed piping, types as indicated, and in accessible locations.

3. Rated Access Panels: Where cleanouts are located at a fire rated wall, provide and install fire-rated access panels to maintain wall rating. Provide panel sized to allow access to the cleanout.

B. Roof Drains:

1. Install roof drains at low points of roof areas, in accordance with the roof membrane manufacturer's installation instructions.
2. Install drain flashing collar or flange so that no leakage occurs between roof drain and adjoining roofing. Maintain integrity of waterproof membranes, where penetrated.
3. Position roof drains so that they are accessible and easy to maintain.
4. Install overflow roof drains with the inlet flow line located a maximum 2-inch above the lowest point of roof.

3.4 SERVICE CONNECTIONS

A. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

3.5 FIELD QUALITY CONTROL

A. Inspections:

1. Do not enclose, cover, or put into operation drainage piping system until it has been inspected and approved by the Authority Having Jurisdiction.
2. During the progress of the installation, notify the Plumbing Official Having Jurisdiction, at least forty-eight (48) hours prior to the time such inspection must be made. Perform tests specified below in the presence of the Plumbing Official.

    a. Rough-In Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
    b. Final Inspection: Arrange for a final inspection to observe the tests specified and to insure compliance with the requirements of the Plumbing Code.

3. Re-Inspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for re-inspection.
4. Reports: Prepare inspection reports, signed by the Plumbing Official.

B. Piping System Test: Test drainage and vent system in accordance with the procedures of the Authority Having Jurisdiction, or in the absence of a published procedure, as follows.

1. Subject all roof drain piping to a water test.
2. Tightly close all openings in the piping system except the highest opening, and fill the system with water to the point of overflow.
3. Maintain water in the system, or in the portion under test, for at least fifteen (15) minutes before inspection starts; the system shall then be tight to all points. No section shall be tested with less than a 10-foot head of water.

4. Close roof drains at the lowest point and fill with water to the point of overflow.

3.6 ADJUSTING AND CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Clean drain strainers, domes, and traps. Remove dirt and debris.

3.7 PROTECTION

A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or whenever work stops. Piping shall not be left open ended during construction.

C. Exposed ABS or PVC Piping: Protect plumbing vents exposed to sunlight with two (2) coats of water-based latex paint. Color selected by Architect.

END OF SECTION 221413

SECTION 221429 - SUMP PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of Sump Pumps Work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of Pumps specified in this section include the following:

1. Submersible Elevator Sump Pumps

C. Pumps furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 22 sections.

D. Refer to other Division 22 sections for insulation of pump housings; vibration control of plumbing pumps; not work of this section.

E. Refer to Division 26 sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on pumps. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
2. Interlock wiring between pumps; and between pumps and field-installed control devices.

a. Interlock wiring specified as factory-installed is work of this section.

F. Provide the following Electrical Work as work of this section, complying with requirements of Division 26 sections:

1. Control wiring between field-installed controls, indicating devices, and pump control panels.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of plumbing pumps with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. HI Compliance: Design, manufacture, and install plumbing pumps in accordance with HI "Hydraulic Institute Standards".
2. UL Compliance: Design, manufacture, and install plumbing pumps in accordance with UL 778 "Motor Operated Water Pumps".

3. UL and NEMA Compliance: Provide electric motors and components which are listed and labeled by Underwriters Laboratories and comply with NEMA Standards.

C. Certification, Pump Performance: Provide pumps whose performances, under specified operating conditions, are certified by manufacturer.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's pump specifications, installation and start-up instructions, and current accurate pump characteristic performance curves with selection points clearly indicated.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to plumbing pumps. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Maintenance Data: Submit maintenance data and parts lists for each type of pump, control, and accessory; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division 1.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Handle plumbing pumps and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged plumbing pumps or components; replace with new.

B. Store plumbing pumps and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with Manufacturer's rigging and installation instructions for unloading plumbing pumps, and moving them to final location.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Submersible Elevator Sump Pumps:

a. Weil Pump Co.

b. Stancor Pumps
c. Bell & Gossett
d. Goulds

2.2 PUMPS

A. General: Provide factory-tested pumps, thoroughly cleaned, and painted with one (1) coat of machinery enamel prior to shipment. Type, size, and capacity of each pump is listed in pump schedule. Provide pumps of same type by same manufacturer.

2.3 PEDESTAL TYPE SUMP PUMPS

A. General: Provide pedestal type sump pumps as indicated, of size and capacity as scheduled.

B. Pump: Centrifugal, semi-open impeller type sump pump, complete with galvanized-steel strainer, cast iron base plate, suction plate and casing, and cast iron or bronze impeller.

C. Shaft: Stainless steel of length to suit depth of basin, connected with flexible coupling to motor, and intermediate sleeve bearing for lengths over 4-feet.

D. Motor: TEFC, electrical characteristics as scheduled.

E. Cover: Steel circular cover with manhole or handhole opening, depending on diameter. Provide openings for pump, control rod, and discharge piping.

F. Controls: Control Panel

1. UL Listed Label
2. NEMA [1] [ ] Enclosure
3. TEST-OFF-AUTO switch for each pump
4. Through-the-door disconnect
5. High Water Alarm (HWA) with 95dB horn
6. Indicator Lights For: Control Power, Pump Run, High Water Alarm, Pump Overload
7. Fused Control Transformer
8. Overload Protection
9. One set of dry contacts for monitoring: HWA
10. Hour Meter for each pump
11. Provide mechanical lever switch complete with float and float rod.

2.4 SUBMERSIBLE ELEVATOR SUMP PUMPS – WITH OIL DETECTION SYSTEM

A. General: Provide submersible sump pumps as indicated, of size and capacity as scheduled.

B. Pump: Cast iron shell, cast iron impeller, stainless steel shaft, factory-sealed grease lubricated ball bearings, ceramic mechanical seal, and perforated steel strainer. The impeller shall be a multi-vane, semi-open type. All exterior hardware shall be 304

stainless steel. Pump shall include a lifting handle to simplify locating and lifting of the pump.

C. Motor: NEMA 6, shall be air filled with Class F insulation. Single phase motors shall include built in automatic reset thermal and overload protection. The motor shaft shall be solid stainless steel. Both upper and lower bearings shall be single sealed and permanently lubricated. The motor cover shall include a cable sealing system to prevent water from entering the motor.

D. Mechanical Seal: Single mechanical seal, carbon against ceramic. All elastomers shall be Buna-N material.

E. Oil Detection System: Provide discriminating liquid sensor probe, wiring, control panel.

F. Controls:

1. Control Panel: Internal logic discriminates between water and hydrocarbon-based liquids with no moving parts. The solid state switching is encased in a rugged housing ensuring dependable service and durability.

a. UL Listed Label
b. NEMA 4X Non-Metallic Enclosure
c. TEST-OFF-AUTO switch for each pump
d. Panel to be constructed to accommodate the scheduled HP and voltage.
e. High Water Alarm (HWA) with 95dB horn and silence button
f. Discriminating Liquid Sensor
g. Pump Shut Down Circuit
h. Hydrocarbon indicator light
i. Hydrocarbon indicator alarm
j. **[25] [ ]** feet of sensor cable
k. Isolated contact for Discriminating Liquid Sensor
l. Fused Control Transformer
m. Single Phase – Automatic reset thermal and overload protection
n. One set of dry contacts for monitoring: HWA
o. Provide 3 tethered float switches. Configure for Off/Stop, Start and High Water Alarm

2.5 SUBMERSIBLE ELEVATOR SUMP PUMPS

A. General: Provide submersible sump pumps as indicated, of size and capacity as scheduled.

B. Pump: Cast iron shell, cast iron impeller, stainless steel shaft, factory-sealed grease lubricated ball bearings, ceramic mechanical seal, and perforated steel strainer. The impeller shall be a multi-vane, semi-open type. All exterior hardware shall be 304 stainless steel. Pump shall include a lifting handle to simplify locating and lifting of the pump.

C. Motor: NEMA 6, shall be air filled with Class F insulation. Single phase motors shall include built in automatic reset thermal and overload protection. The motor shaft shall

be solid stainless steel. Both upper and lower bearings shall be single sealed and permanently lubricated. The motor cover shall include a cable sealing system to prevent water from entering the motor.

D. Mechanical Seal: Single mechanical seal, carbon against ceramic. All elastomers shall be Buna-N material.

E. Controls:

1. Control Panel: Simplex pump control panel The solid state switching is encased in a rugged housing ensuring dependable service and durability.

a. UL Listed Label
b. NEMA 1 Non-Metallic Enclosure
c. TEST-OFF-AUTO switch for each pump
d. Panel to be constructed to accommodate the scheduled HP and voltage.
e. High Water Alarm (HWA) with 95dB horn and silence button
f. Pump Shut Down Circuit
g. Fused Control Transformer
h. Overload Protection
i. One set of dry contacts for monitoring: HWA
j. Provide 3 tethered float switches. Configure for Off/Stop, Start and High Water Alarm

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which plumbing pumps are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF PUMPS

A. General: Install plumbing pumps where indicated, in accordance with manufacturer's published installation instructions, complying with recognized industry practices to ensure that plumbing pumps comply with requirements and serve intended purposes.

B. Access: Provide access space around plumbing pumps for service as indicated, but in no case less than that recommended by manufacturer.

C. Support: Refer to Division 22 section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for support and mounting requirements of plumbing pumps.

D. Basins: Install sump pump basins in indicated locations and connect to sewer lines. Brace interior of basin in accordance with manufacturer's instructions, to prevent distortion or collapse during concrete placement. Refer to Division 3 for concrete work;

not work of this section. Set cover over basin, fasten to top flange of basin. Install so cover is flush with finished floor.

E. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.
   1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

F. Piping Connections: Refer to Division 22 plumbing piping sections. Provide piping, valves, accessories, gauges, supports, and flexible connections as indicated.

3.3 ADJUSTING AND CLEANING

A. Alignment: Check alignment, and where necessary, realign shafts of motors and pumps within recommended tolerances by manufacturer, and in presence of manufacturer's service representative.

B. Start-Up: Start-up in accordance with manufacturer's instructions.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 221429

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of Plumbing Fixtures Work required by this section is indicated on drawings and schedules and by requirements of this section.

1.2 QUALITY ASSURANCE

A. Codes and Standards:

1. ASHRAE Standard 18: "Method of Testing for Rating Drinking Water Coolers with Self-Contained Mechanical Refrigeration Systems".
2. ARI Standard 1010: "Drinking-Fountains and Self-Contained Mechanically-Refrigerated Drinking-Water Coolers".
3. ANSI Standard A117.1: "Specifications for Making Buildings and Facilities Accessible To and Usable By Physically Handicapped People".
4. Public Law 90-480: "Architectural Barriers Act of 1968".
5. International Code Council A117.1: "Accessible and Usable Buildings and Facilities".
6. UL Standard 399: "Drinking-Water Systems Coolers and Health Effects".
7. Public Law 101-336: "Americans With Disabilities Act".
8. NSF Standard 61: "Drinking Water Components".
9. Energy Conservation Act - 1992: "Energy Conservation Standards".
10. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment".
11. International Plumbing Code – Comply with version enforced by the Authority Having Jurisdiction.
12. Safe Water Drinking Act and Amendments and includes Section 1417 requiring not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures.
13. NSF 372: "Drinking Water System Components – Lead Content".

B. Where fixtures are specified as ADA Accessible, it shall be the sole responsibility for all manufacturers and/or suppliers to provide plumbing fixtures and related trim which meet or exceed the ADA Requirements.

1.3 SUBMITTALS

A. Submit under provisions of Division 1 and below.

B. Color Charts: Submit manufacturer's standard color charts for cabinet finishes and fixture colors.

C. Submit certification of compliance with specified NSF, ANSI, UL, and ASHRAE Standards.

D. Submit certification of compliance with performance verification requirements specified in this Section.

1.4 CLOSE-OUT SUBMITTALS

A. Submit under provisions of Division 1.

B. Extra Stock:

1. Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner with receipt in a quantity of one (1) device for each ten (10) fixtures.
2. Furnish faucet repair kits complete with all necessary washers, springs, pins, retainers, packings, O-rings, sleeves, ceramic discs and/or seats in a quantity of one (1) kit for each forty (40) faucets.

C. Maintenance Data: Submit Maintenance Data and Spare Parts Lists for each type of manufactured plumbing fixtures, valves and trim. Include this data, product data, and shop drawings in Maintenance Manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer subject to compliance with requirements, provide products by one of the following:

1. Lavatories, Sinks, Bidets, Service Sinks, Water Closets, Urinals, Bath Tubs, Vitreous China Surgeon Scrub Sinks, Clinical Service Sinks:

a. American Standard U.S. Plumbing Products
b. Kohler Co.
c. Toto

2. Stainless Steel Sinks:

a. Elkay Mfg. Co.
b. Just Mfg. Co.

3. Faucets – Manual Operation:

a. American Standard; U.S. Plumbing Products
b. Chicago Faucet Co.
c. Delta Faucet Co./Cambridge Brass
d. Kohler Co.
e. T & S Brass

f. Sloan Valve Co.
g. Symmons

4. Faucets – Sensor Operation:

a. Sloan Valve Co.
b. Chicago Faucet Co.
c. Delta Faucet Co.
d. T & S Brass
e. American Standard

5. Flush Valves:

a. Sloan Valve Co.

6. Water Closet Seats:

a. Bemis Mfg. Co.
b. Beneke Corp.
c. Church Seats
d. Olsonite Corp.; Olsonite Seats

7. Water Coolers:

a. Elkay Mfg. Co.

8. Fixture Supports:

a. Josam Mfg. Co.
b. Wade
c. Jay R. Smith
d. Zurn Industries, Inc.

9. Mop Service Basins

a. Fiat
b. Stern-Williams
c. Acorn
d. Florestone
e. Swanstone

10. Food Waste Disposers:
a. In-Sink-Erator
b. Waste King
c. Truebro
d. Plumberex Pro-Extreme Series

11. Stops, Supplies, Drains and P-Traps:

a. McGuire
b. Dearborn

c. Brass Craft
d. CS&B Company
e. Watts
f. Nibco
g. Keeney Manufacturing Co.

2.2 WATER CLOSETS

A. Refer To Plumbing Fixture Schedule On Drawings.

2.3 URINALS

A. Refer To Plumbing Fixture Schedule On Drawings.

2.4 LAVATORIES

A. Refer To Plumbing Fixture Schedule On Drawings.

2.5 SINKS

A. Refer To Plumbing Fixture Schedule On Drawings.

2.6 MOP SERVICE BASINS

A. Refer To Plumbing Fixture Schedule On Drawings.

2.7 WATER COOLERS

A. Refer To Plumbing Fixture Schedule On Drawings.

2.8 WASH FOUNTAINS

A. Refer To Plumbing Fixture Schedule On Drawings.

2.9 EMERGENCY EQUIPMENT

A. Refer To Plumbing Fixture Schedule On Drawings.

2.10 WASHER SUPPLY AND DRAIN BOX

A. Refer To Plumbing Fixture Schedule On Drawings.

2.11 FITTINGS, TRIM, AND ACCESSORIES

A. Lead-free supplies and Stops for Lavatories and Sinks: Polished chrome-plated, loose keyed angle stop having 1/2-inch inlet and 3/8-inch O.D. x 12-inch long flexible tubing outlet, and wall flange and chrome-plated cast brass escutcheon with set screw. Quantity to match trim specified. Supplies and stops shall be certified as lead-free in accordance with NSF/ANSI 61 Annex G and/or NSF/ANSI 372.

B. Traps for Drinking Fountains and Lavatories: Chrome-plated cast brass, 1-1/4 inch adjustable "P" trap with cleanout, waste to wall and chrome-plated cast brass escutcheon with set screw.

C. Traps for Sinks: Chrome-plated cast brass, 1-1/2 inch adjustable "P" trap with cleanout, waste to wall and chrome-plated cast brass escutcheon with set screw.

D. Escutcheons: Chrome-plated cast brass with set screw.

E. All handicapped compliant lavatories and sinks, supplies and waste, shall be insulated with molded vinyl covers, Truebro Inc. Lav-Guard Insulation Kit, or equivalent by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify all dimensions by field measurements. Verify that all plumbing fixtures may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

B. Examine rough-in for potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures.

C. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturer's written instructions, rough-in drawings, and pertinent codes and regulations, the original design, and the referenced standards.

B. Comply with the installation requirements of ANSI A117.1 and Public Law 90-480 with respect to plumbing fixtures for the physically handicapped. Arrange flush valve handles with proper orientation to meet ADA requirements.

C. Fasten plumbing fixtures securely to supports or building structure. Secure domestic water piping behind or within wall construction to provide rigid installation.

D. Set shower receptor and mop basins in a leveling bed of cement grout.

E. Install a stop valve in an accessible location in the water connection to each fixture.

F. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork. Escutcheon shall be large enough to cover the hole cut for the pipe penetration.

G. Seal fixtures to walls and floors using silicone sealant as specified in Division 7. Match sealant color to fixture color.

H. Visible parts of fixture brass and accessories shall be chrome-plated.

I. External finishes on all trim shall not be chrome-plated plastic.

J. Where possible, fixtures shall be the product of one manufacturer. Where possible, fittings of same type shall be the product of one manufacturer.

K. Install hose end faucets and hose connection with vacuum breakers.

L. Solidly attach floor-mounted water closets to cast iron water closet flange with brass bolts, washers and nuts.

3.3 FIELD QUALITY CONTROL

A. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning units, then retest.

B. Inspect each installed unit for damage. Replace damaged fixtures.

3.4 ADJUSTING

A. Adjust water pressure at drinking fountains, faucets, shower valves, and flush valves to provide proper flow and stream.

B. Replace washers of leaking or dripping faucets and stops.

C. Clean fixtures, trim, and strainers using manufacturer's recommended cleaning methods and materials.

3.5 CLEANING

A. Clean fixtures, trim, and strainers using manufacturer's recommended cleaning methods and materials.

3.6 PROTECTION

A. Provide protective covering for installed fixtures, water coolers, and trim.

B. Do not allow use of fixtures for temporary facilities unless expressly approved in writing by the Owner.

3.7 MOUNTING HEIGHTS SCHEDULE

A. Fixture mounting height and rough-in dimensions shall be as indicated on the Architectural Drawings and Specifications.

END OF SECTION 223300

SECTION 230000 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including the **General and Supplementary Conditions, Division-1 Conditions** specification sections apply to the Division 23 specifications and drawings.

B. Related Sections: Refer to all sections in Division 23. Refer to Division 26 specification section and Division 26 drawings.

1.2 SUMMARY

A. This Section specifies the basic requirements for mechanical installations and includes requirements common to more than one (1) section of Division 23. It expands and supplements the requirements specified in sections of Division 1.

B. The Contractor shall coordinate and co-operate with Owner at all times for all new to existing connections, system shutdowns and restart-up, flushing and filling both new and existing systems.

C. Provide temporary ductwork and piping services where required to maintain existing areas operable, or as shown on the drawings.

D. Coordinate all services shutdown with the Owner, provide temporary services as shown on the drawings.

E. Relocate existing thermostats as shown on the drawings.

F. The Contractor shall be responsible for the maintenance operation and servicing of all new mechanical systems which are to be used by the Owner during the time of any occupancy and use of any areas within the construction limitations before final completion or acceptance of the systems. A written record of maintenance, operation and servicing shall be turned over to the Owner prior to final acceptance.

1.3 PROJECT CONDITIONS

A. The Contractor shall be required to attend a mandatory pre-bid walk-thru and shall make themselves familiar with the existing conditions. No additional costs to the Owner shall be accepted for additional work for these existing conditions.

B. Field verify all existing conditions prior to submitting bids.

C. Report any existing damaged equipment or systems to the Owner prior to any work.

D. Protect all mechanical and electrical work against theft, injury or damage from all causes until it has been tested and accepted.

E. Be responsible for all damage to the property of the Owner or to the work of other contractors during the construction and guarantee period. Repair or replace any part of the Work which may show defect during one (1) year from the final acceptance of all work. Provided such defect is, in the opinion of the Architect, due to imperfect material or workmanship and not due to the Owner's carelessness or improper use.

1.4 ACCESSIBILITY

A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow minimum of 30" working clearance for removal of all parts that require replacement or servicing.

B. Extend all grease fittings to an accessible location.

C. Furnish hinged steel access doors with concealed latch, whether shown on drawings or not, in all walls and ceilings for access to all concealed valves, shock absorbers, air vents, motors, fans, balancing cocks, and other operating devices requiring adjustment or servicing. Refer to Division 1 for access door specification and Division 23 for duct access door requirements.

D. The minimum size of any access door shall not be less than the size of the equipment to be removed or 24-inch x 24-inch if used for service only.

E. Furnish doors to trades performing work in which they are to be built, in ample time for building-in as the work progresses. Whenever possible, group valves, cocks, etc., to permit use of minimum number of access doors within a given room or space.

F. Factory manufactured doors shall be of a type compatible with the finish in which they are to be installed. In lieu of these doors, shop fabricated access doors with DuroDyne hinges may be used.

G. Access doors in fire-rated walls and ceilings shall have equivalent UL label and fire rating.

1.5 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment shop drawings and manufacturer's requirements for actual provided equipment for rough-in requirements.

1.6 REQUIREMENTS OF REGULATORY AGENCIES

A. Refer to Division 1.

B. Execute and inspect all work in accordance with all Underwriters, local and state codes, rules and regulations applicable to the trade affected as a minimum, but if the plans and/or specifications call for requirements that exceed these rules and regulations, the greater requirement shall be followed. Follow recommendations of NFPA, SMACNA, EPA, OSHA and ASHRAE.

C. Comply with standards in effect at the date of these Contract Documents, except where a standard or specific date or edition is indicated.

D. The handling, removal and disposal of regulated refrigerants shall be in accordance with U.S. EPA, state and local regulations.

E. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

1.7 REQUIREMENTS OF LOCAL UTILITY COMPANIES

A. Comply with rules and regulations of local utility companies. Include in bid the cost of all valves, valve boxes, meter boxes, meters and such accessory equipment which will be required for the project.

1.8 PERMITS AND FEES

A. Refer to Division 1.

B. Owner shall pay all tap, development, meter, etc., fees required for connection to municipal and public utility facilities.

C. Contractor shall arrange for and pay for all inspections, licenses and certificates required in connection with the Work.

1.9 MECHANICAL INSTALLATIONS

A. Drawings are diagrammatic in character and do not necessarily indicate every required offset, valve, fitting, etc.

B. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both.

C. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurement, take the necessary measurements and prepare the drawings.

D. Before any Work is installed, determine that equipment will properly fit the space; that required piping grades can be maintained and that ductwork can be run as contemplated

without interferences between systems, with structural elements or with the work of other trades.

E. Coordinate the installation of mechanical materials and equipment above and below ceilings with suspension system, light fixtures, and other building components.

1. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electric systems within the cavity space allocation in the following order of priority.

a. Plumbing waste, vent piping and roof drain mains and leaders
b. Supply, return and exhaust ductwork
c. Fire sprinkler mains and leaders
d. Electrical conduit
e. Domestic hot and cold water, medical gas piping
f. Fire sprinkler branch piping and sprinkler runouts

F. Verify all dimensions by field measurements.

G. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.

H. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

I. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

J. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials.

K. Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible.

L. Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

M. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

1.10 EXCAVATING AND BACKFILLING

A. General:

1. Provide all necessary excavation and backfill for installation of Mechanical Work in accordance with Division 31 and Division 23.
2. In general, follow all regulations of OSHA as specified in Part 1926, Subpart P, "Excavations, Trenching and Shoring". Follow specifications of Division 23 as they refer specifically to the Mechanical Work.

B. Contact Owners of all underground utilities to have them located and marked, at least two (2) business days before excavation is to begin. Also, prior to starting excavation, brief employees on marking and color codes and train employees on excavation and safety procedures for natural gas lines. When excavation approaches gas lines, expose lines by carefully probing and hand digging.

C. Provide all necessary pumping, cribbing and shoring.

D. Walls of all trenches shall be a minimum of 6-inch clearance from the side of the nearest mechanical work. Install pipes with a minimum of 6-inch clearance between them when located in same trench.

E. Pipe Trenching:

1. Dig trenches to depth, width, configuration, and grade appropriate to the piping being installed. Dig trenches to 6-inches below the level of the bottom of the pipe to be installed. Install 6-inch bed of pea gravel or squeegee; mechanically tamp to provide a firm bed for piping, true to line and grade without irregularity. Provide depressions only at hubs, couplings, flanges, or other normal pipe protrusions.

F. Backfilling shall not be started until all work has been inspected, tested and accepted. All backfill material shall be reviewed by the Soils Engineer. In no case shall lumber, metal or other debris be buried in with backfill.

G. Trench Backfill:

1. Backfill to 12-inches above top of piping with pea gravel or squeegee, the same as used for piping bed, compact properly.
2. Continue backfill to finish grade, using friable material free of rock and other debris. Install in 6-inch layers, each properly moistened and mechanically compacted prior to installation of ensuing layer. Compaction by hydraulic jetting is <u>not</u> permissible.

H. After backfilling and compacting, any settling shall be refilled, tamped, and refinished at this Contractor's expense.

I. This Contractor shall repair and pay for any damage to finished surfaces.

J. Complete the backfilling near manholes using pea gravel or squeegee, installing it in 6-inch lifts and mechanically tamping to achieve 95 percent compaction.

K. Use suitable excavated material to complete the backfill, installed in 6-inch lifts and mechanically compacted to seal against water infiltration. Compact to 95 percent for the upper 30-inches below paving and slabs and 90 percent elsewhere.

1.11 CUTTING AND PATCHING

A. This Article specifies the cutting and patching of mechanical equipment, components, and materials to include removal and legal disposal of selected materials, components, and equipment.

B. Refer to Division 1.

C. Do not endanger or damage installed work through procedures and processes of cutting and patching.

D. Arrange for repairs required to restore other work, because of damage caused as a result of mechanical installations.

E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.

F. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover work to provide for installation of ill-timed work;
2. Remove and replace defective work;
3. Remove and replace work not conforming to requirements of the Contract Documents;
4. Remove samples of installed work as specified for testing;
5. Install equipment and materials in existing structures;
6. Upon written instructions from the Architect, uncover and restore work to provide for Architect observation of concealed work.

G. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including, but not limited to removal of mechanical piping, heating units, and other mechanical items made obsolete by the new work.

H. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

I. Provide and maintain an approved type of temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

J. Locate, identify, and protect mechanical and electrical services passing through remodeling or demolition area and serving other areas required to be maintained operational. **When services must be interrupted, provide temporary services for the affected areas and notify the Owner prior to changeover.**

1.12 TEMPORARY FACILITIES

A. Light, Heat, Power, Etc.:

1. Responsibility for providing temporary electricity, heat and other facilities shall be as specified in Division 1.

B. Use of Permanent Building Equipment for Temporary Heating or Cooling:

1. Permanent building equipment shall not be used without written permission from the Owner. If this equipment is used for temporary heating or cooling, it shall be adequately maintained per manufacturer's instructions and protected with filters, strainers, controls, reliefs, etc. The guarantee period shall not start until the equipment is turned over to the Owner for his use.

1.13 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Materials and equipment of equivalent quality may be substituted for those scheduled or identified by name on the drawings if so reviewed by the Architect Engineer and Owner prior to bidding. This may be done by submitting to the Architect, at least seven (7) working days prior to the bid date, a letter in triplicate requesting prior review. This submittal shall include all data necessary for complete evaluation of the substitution and publication in written Addenda.

1.14 MECHANICAL SUBMITTALS

A. Refer to the Conditions of the Contract (General and Supplementary), Division 1 and AIA Document A201 (1987) Edition, "SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES".

B. The manufacturer's material or equipment listed in the schedule or identified by name on the drawings are the types to be provided for the establishment of size, capacity, grade and quality. If alternates are used in lieu of the scheduled names, the cost of any changes in construction required by their use shall be borne by Contractor.

C. All equipment shall conform to the State and/or Local Energy Conservation Standards.

D. Submittal of shop drawings, product data, and samples will be accepted only when submitted by and stamped by the Contractor. Data submitted from subcontractors and material suppliers directly to the Architect will not be processed unless prior written approval is obtained by the Contractor.

E. Submit all submittal items required for each Specification Section partial submittals for portions of the Work are indicated on approved submittal schedule.

F. If more than two (2) submittals (either for shop drawings or for as-built drawings) are made by the Contractor, the Owner reserves the right to charge the Contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the Contractor.

G. Before starting Work, prepare and submit to the Architect all shop drawings and descriptive equipment data required for the project. Unless each item is identified with specification section and sufficient data to identify its compliance with the specifications and drawings, the item will be returned without action or "Revise and Resubmit". Continue to submit shop drawings after each Engineer's action, until a "Reviewed" action is received. The Contractor shall submit the total number of sets as called for in Division 1 to the Architect for final distribution. Submittals shall include the following specified materials and, in addition, any materials not listed below but which are specified in the individual sections of Division 23 which follow.

1. Pipe Markers
2. Valves, including pressure relief and pressure regulating
3. Piping specialties
4. Supports, anchors and seals
5. Flexible pipe connectors
6. Insulation, including plastic pipe fitting insulation covers and manufacturer's installation instructions
7. Air conditioning equipment and specialties
8. Fans, ductwork, dampers, louvers, grilles, registers and diffusers
9. Automatic control systems

H. Wiring diagrams, control panelboards, motor test data, motors, starters and controls for electrically operated equipment furnished by mechanical trades.

I. Identify each item with specification section and sufficient data to certify its compliance with the specifications.

J. Electronic submittals shall be packaged as a bookmarked multi-page single PDF file and shall not be over 5MB. Electronic Submittals over 5MB will not be accepted and will be returned un-reviewed.

1.15 REQUESTS FOR INFORMATION

A. All "Requests for Information" submitted by the Contractor shall include a proposed solution and an estimated cost/schedule impact. Any RFI's that do not contain this required information will be sent back to the Contractor unanswered.

1.16 MECHANICAL COORDINATION DRAWINGS

A. Prepare and submit a complete set of 3-D Coordination/Fabrication Drawings showing major elements, components, and systems of mechanical equipment and materials in relationship with other trades, sub-trades and building components. Prepare drawings within the remodeled area "Model" to an accurate scale of 1/4"=1'-0" or larger when plotted. Indicate the locations of all equipment and materials, including clearances for installing and maintaining insulation, servicing and maintaining equipment, valve stem movement, and similar requirements. Indicate movement and positioning of large equipment into the building during construction.

B. Review in detail all floor plans, reflected ceiling plans, elevations, sections, and details to conclusively coordinate with all trades and integrate all installations. Indicate locations where space is limited, and where sequencing and coordination of installations are of importance to the efficient flow of the work, including (but not necessarily limited to) the following:

1. Specific equipment installations, including:

    a. Air Handling Units;

2. Work in pipe spaces, chases, trenches, and tunnels;
3. Exterior wall penetrations;
4. Ceiling plenums which contain piping, ductwork, or equipment in congested arrangement;
5. Installations in mechanical riser shafts, at typical sections and crucial offsets and junctures;
6. Pipe expansion loops;
7. Numbered valve location diagrams;
8. Manifold piping for multiple equipment units;

1.17 PRODUCT LISTING

A. Prepare listing of major mechanical equipment and materials for the project, within two (2) weeks of signing the Contract Documents and transmit to the Mechanical Engineer.

B. Unless otherwise specified, all materials and equipment shall be of domestic (USA) manufacture and shall be of the best quality used for the purpose in commercial practice.

C. Provide all information requested.

D. Submit this listing as a part of the submittal requirement specified in Division 1, "PRODUCTS AND SUBSTITUTION".

E. When two (2) or more items of same material or equipment are required (pumps, valves, air conditioning units, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in work, except as otherwise indicated.

F. Provide products which are compatible within systems and other connected items.

1.18 NAMEPLATE DATA

A. Provide permanent operational data nameplate on each item of mechanical equipment, indicating manufacturer, product name, model number, serial number, efficiency rating (i.e. EER, etc.) capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

1.19 DELIVERY, STORAGE, AND HANDLING

A. Refer to Division 1.

B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

C. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage, dirt, dust and moisture.

D. Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

E. Provide factory-applied plastic end-caps on each length of pipe and tube, except for concrete, corrugated metal, hub-and-spigot, clay pipe. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

F. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.

G. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.20 RECORD DOCUMENTS

A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.

B. Keep a complete set of record document prints or electronic mark-ups in custody during entire period of construction at the construction site.

C. Mark drawing prints to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes, and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; 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.); RFI's; change orders; concealed control system devices. Changes to be noted on the drawings shall include final location of any piping or ductwork relocated more than 1'-0" from where shown on the drawings.

D. Mark Equipment Schedules on the drawings with changes to Manufacturer, Model Number, and data based on reviewed shop drawings.

E. At the completion of the project, mark all valve tag numbers on the drawings and turn these drawings over to the General Contractor for his submission to the Architect. This Contract will not be considered completed until these record drawings have been received and reviewed by the Architect.

1.21 OPERATION AND MAINTENANCE DATA

A. Refer to Division 1.

[OR]

B. No later than four (4) weeks prior to the completion of the project, make-up minimum of four (4) electronic disk sets copies and one hard copy of Operating and Maintenance Manuals, as specified in sections of Division 1.

C. The Testing and Balancing Report shall be submitted and received by the Engineer at least five (5) calendar days prior to the Contractor's request for final observation time frame requirements. Final Observation(s) will not proceed without T&B Report. Include in the O&M Manual after review with "Review" or "Make Corrections Noted" has been accomplished.

D. In addition to the information required above and/or by Division 1 for maintenance data, include the following information:

1. Description of mechanical equipment, function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.
5. Manufacturer's service manuals for all mechanical equipment provided under this Contract.
6. Include the valve tag list.
7. Name, Address and Telephone Number of party to be contacted for twenty-four (24) hour service for each item of equipment.
8. Starting, stopping, lubrication, equipment identification numbers and adjustment clearly indicated for each piece of equipment.
9. Complete parts list.
10. Mechanical warranties.

E. This Contract will not be considered completed, nor will final payment be made, until all specified material, including Testing and Balancing Report, is received in this Operating and Maintenance Report and the manual is reviewed by the Architect.

1.22 LUBRICATION OF EQUIPMENT

A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.

B. Contractor shall properly lubricate all mechanical pieces of equipment which he provided before turning the building over to the Owner. He shall attach a linen tag or heavy duty shipping tag on the piece of equipment showing the date of lubrication and the type and brand of lubricant used.

C. Furnish the Engineer with a typewritten list in quadruplicate, of each item lubricated and type of lubricant used, no later than two (2) weeks before completion of the project, or at time of acceptance by the Owner of a portion of the building and the mechanical systems involved.

1.23 DEMOLITION

A. Refer to Division 1. The following paragraphs supplement the requirements of Division 1.

B. During the demolition phase of this Contract, it is the responsibility of this Contractor to carefully remove existing equipment, piping or ductwork and related items either as shown on the demolition drawings as being removed, or as required for the work. These items shall be tagged, protected from damage, and stored as directed by the Architect. A list of all items stored shall be turned over to the Architect. At the completion of the remodeling work or when directed by the Architect, all stored items not reused or wanted by the Owner shall be removed from the premises. Disposition of items not reused is by the direction of the Architect.

1. Replace existing thermostats wherever possible in work area.
2. Return all demolished control valves and devices to the Owner.

C. The location of existing equipment, pipes, ductwork, etc., shown on the drawings has been taken from existing drawings and field survey and is, therefore, as accurate as that information may be without complete unobstructed view above ceilings, in walls or below the floor. All existing conditions shall be verified from field measurements with necessary adjustment being made to the drawing information.

D. If asbestos material, in any form, is discovered by this Contractor in the process of his work, he shall report such occurrence to the Architect immediately. The Architect will determine the action to be taken for the asbestos removal, which is not a part of the work to be done under this Division.

1.24 WARRANTIES

A. Refer to Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. In any case, the entire mechanical system shall be warranted no less than one (1) year from the time of acceptance by the Owner.

B. Compile and assemble the warranties specified in Division 23, into the Operating and Maintenance Manuals.

C. Provide complete warranty information for each item to include product or equipment to include date or beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.25 CLEANING

A. Refer to Division 1.

B. Refer to Division 23, "TESTING, ADJUSTING AND BALANCING" for requirements for cleaning filters, strainers, and mechanical systems prior to final acceptance.

END OF SECTION 230000

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of Piping Specialties Work required by this section is indicated on drawings and schedules and by requirements of this section.

B. Types of Piping Specialties specified in this section include the following:

1. Escutcheons
2. Mechanical Sleeve Seal
3. Drip Pan
4. Pipe Sleeve
5. Sleeve Seals

C. Piping Specialties furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 23 sections.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of piping specialties of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. ASME B 31.9 "Building Services Piping" for materials, products, and installation.
2. Safety valves and pressure vessels shall bear the appropriate ASME label.
3. Fabricate and stamp air separators and compression tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
4. ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualification" for qualifications for welding processes and operators.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions, and dimensioned drawings for each type of manufactured piping specialty. Submit schedule showing manufacturer's figure number, size, location, and features for each required piping specialty.

B. Shop Drawings: Submit for fabricated specialties, indicating details of fabrication, materials, and method of support.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of manufactured piping specialty. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Divisions 23.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Pipe Escutcheons:

   a. Chicago Specialty Mfg. Co.
   b. Producers Specialty & Mfg. Corp.
   c. Sanitary-Dash Mfg. Co.

2. Mechanical Sleeve Seal:

   a. Thunderline Corp.
   b. "Metraseal" by Metraflex Co.

3. Fire and Smoke Barrier Penetration Seal:

   a. Electrical Products Division/3M
   b. Dow Corning
   c. Flame Stop, Inc.
   d. MetaCaulk
   e. Hilti
   f. HoldRite

2.2 PIPE ESCUTCHEONS

A. General: Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.

C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.

2.3 MECHANICAL SLEEVE SEALS

A. General: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.4 FIRE AND SMOKE BARRIER PENETRATION SEALS

A. General: Provide UL Listed firestopping systems composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

B. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

C. Penetrations in Fire Resistive Rated Walls: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

1. F-Rating: Not less than the fire-resistance rating of the wall construction being penetrated.

D. Penetration in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E 814.

1. F-Rating: Minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
2. T-Rating: When penetrant is located outside of a wall cavity, minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
3. W-Rating: Class 1 rating in accordance with water leakage test per UL 1479.

E. Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with UL1479 or ASTM E 814.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at both ambient and elevated temperatures.

2.5 FABRICATED PIPING SPECIALTIES

A. Drip Pans: Provide drip pans fabricated from corrosion-resistant sheet metal with watertight joints, and with edges turned up 2-1/2 inch, and with double sloped to drain bottom. Reinforce top, either by structural angles or by rolling top over 1/4-inch steel rod. Provide hole, gasket, and flange at low point for watertight joint and 1-inch drain line connection. Provide drip pan overflow sensors/alarms or visual overflow piping in compliance with IMC.

1. Drip pans shall be located under the drainage piping at the following locations, whether these areas have ceilings or not.

    a. Electronic Data Processing Areas
    b. Electrical Closets
    c. Other Sensitive Areas

B. Pipe Sleeves: Provide pipe sleeves of one (1) of the following:

1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gauges: 3-inch and smaller, 20 gauge; 4-inch to 6-inch, 16 gauge; over 6-inch, 14 gauge.
2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
3. Iron Pipe: Fabricate from cast iron or ductile iron pipe; remove burrs.

C. Sleeve Seals: Provide sleeve seals for sleeves located in foundation walls below grade, or in exterior walls, of one (1) of the following:

1. Mechanical Sleeve Seals: Installed between sleeve and pipe.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Pipe Escutcheons: Install pipe escutcheons on each pipe penetration through floors, walls, partitions, and ceilings where penetration is exposed to view; and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surface.

B. Mechanical Sleeve Seals: Loosely assemble rubber links around pipe with bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.

C. Fire or Fire/Smoke Barrier Penetration Seals: Where pipe penetration occurs in fire or fire/smoke rated walls, provide a complete listed protection assembly equal to the rating of the wall/floor.

D. Provide dielectric waterways or insulating flanges, as required by pipe size, on all connections of dissimilar metals.

3.2 SLEEVES AND SEALS

A. Pipes:

1. Pipes:

a. New Construction: Pipes penetrating concrete or masonry construction, whether insulated or not, shall be provided with sheet metal or pipe sleeves fitted into place at time of construction. In poured concrete, the sleeves shall be steel pipe with a full circle, continuously welded water stop plate to also act as a sleeve anchor. When installing Link-Seal the sleeve and Link-Seal shall be of matched sizes. Otherwise, sleeves shall be of such size to provide all around clearance of 1/4-inch to 1-inch. Seal entire space between pipe and sleeve with fire stopping as specified in "Seals".

b. Existing Construction: For existing construction or masonry construction, prepare pipe opening by carefully cutting or core drilling, install sheet metal sleeve, and fill any open space with material assembly equal to the listing of the wall. Cutting of concrete or masonry shall be done after approval of Structural Engineer.

c. Sleeves in non-fire rated or non-bearing walls, floors or ceilings, new or existing construction, shall be steel pipe or galvanized sheet metal with lock-type longitudinal seam. Pack all open spaces on each end with mineral wood or other non-combustible material, positively fastened in place. Asbestos is not acceptable.

d. Where a pipe of any description passes through a concrete floor, the sleeve shall extend at least 2-inch above the finished floor, except when using the ProSet Systems.

e. At Contractor's option, where uninsulated pipes penetrate cast-in-place concrete floors, the "ProSet Systems," Atlanta, Georgia, sleeving may be employed.

f. For pipes penetrating foundation walls, water-proofing membrane floors or other places where water leakage could be encountered, install Link-Seal wall sleeves by Thunderline Corporation in manner recommended by the manufacturer.

B. Where pipe penetrations occur in non-fire rated floors, roof slabs, or walls, the space between pipe insert and the sleeve shall be packed on each end with mineral wool or other non-combustible material, positively fastened in place. Use plenum rated caulk to seal packing around pipe.

C. Seals:

1. General:

a. Seal all holes or voids where mechanical systems penetrate fire rated floors and walls with a fire stopping sealant having a fire rating equal to or greater than that of the construction being penetrated. The sealant shall meet the requirements of ASTM E-814, ASTM E-119 and UL-1479. It shall be installed with strict adherence to the manufacturer's instructions and according to the product's UL Laboratory listing. The use of asbestos in any form is not permitted.

2. Conduct tests according to manufacturer's written recommendations to verify that substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt and other foreign substances capable of impairing bond of firestoping.

3. Do not cover firestopping with other construction until approval of authority having jurisdiction has been received.

D. Escutcheons:

1. In finished parts of the building, after painting is completed, install chromium plated escutcheons on all pipes passing through walls and floors where piping is exposed to view.

E. Flash and counterflash where mechanical equipment passes through weather or water-proofed walls, floors, and roofs per roof manufacturer's instructions.

3.3 INSTALLATION OF FABRICATED PIPING SPECIALTIES

A. Drip Pans: Locate drip pans under piping as indicated. Hang from structure with rods and building attachments, weld rods to sides of drip pan. Brace to prevent sagging or swaying. Connect 1-inch drain line to drain connection, and run to nearest plumbing drain or elsewhere as indicated.

B. Pipe Sleeves: Install pipe sleeves of types indicated where piping passes through walls, floors, ceilings, and roofs. Do not install sleeves through structural members of work, except as detailed on drawings, or as reviewed by Architect/Engineer. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insert will have free movement in sleeve, including allowance for thermal expansion; but not less than two (2) pipe sizes larger than piping run. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves. Extend floor sleeves in rooms **[_____]** 1/2-inch above level floor finish, in rooms **[_____]** 3/4-inch above floor finish sloped to drain and 4-inch above finished floor in all Mechanical Equipment Rooms and pipe chases. Provide temporary support of sleeves during placement of concrete and other work around sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeves.

1. Install sheet metal sleeves at interior partitions and ceilings other than suspended ceilings.
2. Install iron pipe sleeves at exterior penetrations; both above and below grade.
3. Install steel pipe sleeves except as otherwise indicated.

END OF SECTION 230500

SECTION 230529 - SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of Supports and Anchors required by this section is indicated on drawings and/or specified in other Division 23 sections.

B. Types of Supports and Anchors specified in this section include the following:

1. Piping Hangers and Supports
2. Vertical-Piping Clamps
3. Hanger-Rod Attachments
4. Building Attachments
5. Saddles and Shields
6. Miscellaneous Materials
7. Anchors

C. Supports and anchors furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 23 sections.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. Regulatory Requirements: Comply with applicable Mechanical Codes pertaining to product materials and installation of supports and anchors.
2. Duct Hangers: SMACNA Duct Manuals.
3. MSS Standard Compliance:

a. Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing manufacturer's figure number, size, location, and features for each required pipe hanger and support.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

C. Product certificates signed by the manufacturer of hangers and supports certifying that their products meet the specified requirements.

D. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Pipe Hangers and Supports:

    a. B-Line Systems Inc.
    b. Carpenter and Patterson, Inc.
    c. Fee & Mason Mfg. Co.; Division Figgie International
    d. PHD Manufacturing, Inc.
    e. Elcen Metal Products Company
    f. Erico/Caddy
    g. Unistrut Metal Framing Systems
    h. Hilti USA.
    i. Advanced Thermal Systems
    j. Anvil

2. Saddles and Shields:

    a. B-Line Systems, Inc.
    b. Pipe Shields, Inc.
    c. Insulation Pipe Supports Manufacturing
    d. Insulated Saddle Shield Insert Product Inc.
    e. Erico/Caddy
    f. Component Products Co.
    g. Value Engineered Products, Inc.
    h. Snappitz Pipe Inserts by Mechanical Pipe Shields, Inc.
    i. Anvil

3. Concrete Inserts and Anchors:

    a. Phillips Drill Company
    b. Erico/Caddy
    c. Elcen Metal Products Company
    d. Ramset/Red Head

e. Hilti USA.
f. Star fasteners
g. B-Line
h. Blue Banger Hanger

2.2 PIPE HANGERS AND SUPPORTS

A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.

1. Components shall have galvanized coatings where installed for piping and equipment that will not have field-applied finish.
2. Pipe attachments shall have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

B. Adjustable Clevis Hanger: MSS Type 1

1. Steel Pipe, size 3/8-inch thru 12-inch, B-Line B3100
2. Copper Pipe, size 1/2-inch thru 4-inch, B-Line B3104CT

C. Adjustable Swivel Ring: MSS Type 10

1. Steel Pipe, size 1/2-inch thru 2-inch, B-Line B3170NF
2. Copper Pipe, size 1/2-inch thru 2-inch, B-Line B3170CT

D. Standard Pipe Clamps: MSS Type 8

1. Steel Pipe, size 3/4-inch thru 20-inch, B-Line B3373
2. Copper Pipe, size 1/2-inch thru 4-inch, B-Line B3373CT

E. Hanger Rods: Continuous threaded steel, sizes as specified.

F. Pipe Alignment Guides:

1. Provide factory-fabricated guides, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

a. Steel Pipe, B-Line B3281 through B3287

2.3 UPPER ATTACHMENTS

A. Beam Clamps

1. All thread rod sized 3/8-inch and 1/2-inch: B-Line B3034
2. All thread rod sizes 5/8- inch: B-Line B3033
3. All thread rod sizes 3/4-inch and up: B-Line B3055

2.4 CONCRETE INSERTS AND ANCHORS

A. Inserts: Case shall be of galvanized carbon steel with square threaded concrete insert nut for hanger rod connection; 3/4-inch lateral adjustment; top lugs for reinforcing rods, nail holes for attaching to forms. Erico Hanger Models 355 and 355N or equal Unistrut or Elcen. This type of upper attachment is to be used for all areas having poured in place concrete construction.

B. Anchors: Carbon steel, zinc plated. Installation shall be in holes drilled with carbide-tipped drill bits or by use of self-drilling anchors.

1. Provide anchors suitable for the location of installation and designed to withstand all forces and movements acting in the anchor. Manufacture pipe anchors in accordance with MSS SP 58. Provide a safety factor of four (4) for the anchor installation.
2. Powder driven fasteners subject to approval of Structural Engineer. Each fastener shall be capable of holding a test load of 1,000 pounds whereas the actual load shall not exceed 50 pounds.
3. Self-drilling expansion shields. The load applied shall not exceed one-fourth the proof test load required.
4. Machine bolt expansion anchor. The load applied shall not exceed one-fourth the proof test load required.

2.5 SADDLES AND THERMAL SHIELD INSERTS AND PROTECTIVE SHIELDS

A. General: Provide saddles and thermal shield inserts under all insulated piping hangers. Provide thermal shield inserts on all piping through floors, wall and roof construction penetrations. Size saddles and thermal shield inserts for exact fit to mate with pipe insulation or a minimum of 1-inch thick for uninsulated pipe thermal shield inserts.

B. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation. For use with roller Hangers.

1. B-Line B3160 to B3165

C. Galvanized Steel Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation or insert. (Considering weight, use, temperature). See also Part 3.G.3.

D. Thermal Shield Inserts: Provide 100-psi average compressive strength, waterproof, asbestos free calcium silicate, encased with a sheet metal enclosure or other listed system manufacturers. Insert and shield shall cover the entire circumference on vertical pipes, or the bottom half circumference of the pipe on horizontal mounting supports, and shall be of length recommended by the manufacturer for pipe size and thickness of insulation or the thickness of the wall, roof or floor construction.

E. Thermal Mechanical Pipe Shields: Self-locking insulated pipe supports/shields shall be provided at hanger, support, and guide locations on pipe requiring insulation. The insert shall consist of either hydrous calcium silicate or polyisocyanurate foam insulation (urethane) encircling the entire circumference of the pipe. Provide with a 360 degree

PVC or Galvanized steel jacket which complies with the International Mechanical Code for installation in plenum ceilings where applicable. The length of the jacket shall be sized for pipe expansion.

2.6 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

C. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS Standards.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments. **Review Structural Drawings to obtain structural support limitations.**

B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at Project Site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified. **Provide Shop Drawing showing method and support locations from structure.**

3.3 INSTALLATION OF BUILDING ATTACHMENTS

A. Install building attachments within concrete or on structural steel. Space attachments within maximum piping span length indicated in MSS SP-69 and tables this section. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive

strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.

B. New Construction:

1. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.
2. Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 4-inch or ducts over 60-inch wide.
3. Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
4. Use drop-in anchors for concrete structures.
5. Use beam clamps for steel structures.

C. Existing Construction:

1. In existing concrete construction, drill into concrete slab and insert and tighten expansion anchor bolt. Connect anchor bolt to hanger rod. Care must be taken in existing concrete construction not to sever reinforcement rods or tension wires.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

A. Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69 and SP-89. Arrange for grouping of parallel runs of horizontal piping to be supported together on field fabricated, heavy-duty trapeze hangers where possible. Install supports with maximum spacings complying with MSS SP-69 and tables this section. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.

C. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

D. Install hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, to facilitate action of expansion joints, expansion loops, expansion bends and similar units and within 1'-0" of each horizontal elbow.

E. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31.9 Building Services Piping Code is not exceeded.

G. Insulated Piping: Comply with the following installation requirements:

1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
2. Saddles: Install Protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
3. Thermal Protective Metal Shields : Install thermal protective shields MSS Type 40 on cold and chilled water piping that is insulated. Thermal protective shields shall span an arc of 180 degrees and shall have dimensions in inches not less than the following:

NPS	Length	Metal Shield Thickness
1/4 thru 3-1/2	12	0.048
4	12	0.060
5 and 6	18	0.060

4. Thermal shield inserts shall be provided where thermal protective metal shields are provided and shall span an arc of 180 degrees and shall match the length of the thermal protective shield.

H. Install hydronic piping (copper and steel) hangers with the following minimum rod sizes and maximum spacing:

	Sch. 40 & Sch. 80 Steel Pipe		
Pipe Size	Maximum Hanger Spacing (ft.)	Maximum Vertical Spacing (ft.)	Minimum Rod Size (in.)
1/2"	7	15	3/8
3/4"	7	15	3/8
1"	7	15	3/8
1-1/4"	7	15	3/8
1-1/2"	9	15	3/8
2"	10	15	3/8
2-1/2"	11	15	1/2
3"	12	15	1/2
4"	12	15	5/8
5"	12	15	5/8
6"	12	15	3/4
Based on MSS-69, IMC & IFGC.			

Pipe Size	Type K, L, M Copper Pipe		
	Maximum Hanger Spacing (ft.)	Maximum Vertical Spacing (ft.)	Minimum Rod Size (in.)
1/2"	5	10	3/8
3/4"	5	10	3/8
1"	6	10	3/8
1-1/4"	6	10	3/8
1-1/2"	8	10	3/8
2"	8	10	3/8
2-1/2"	9	10	1/2
3"	10	10	1/2
4"	10	10	1/2
5"	10	10	1/2
6"	10	10	5/8
Based on MSS-69 & IMC.			

Pipe Size	PEX Tubing		
	Maximum Hanger Spacing (ft.)	Maximum Vertical Spacing (ft.)	Minimum Rod Size (in.)
All	2.67	10	3/8
Based on MSS-69 & IMC.			

Pipe Size	PVC & CPVC (20-110 Degree F.)		
	Maximum Hanger Spacing (ft.)	Maximum Vertical Spacing (ft.)	Minimum Rod Size (in.)
1/2"	3	10	3/8
3/4"	3	10	3/8
1"	3	10	3/8
1-1/4"	4	10	3/8
1-1/2"	4	10	3/8
2"	4	10	3/8
2-1/2"	4	10	1/2
3"	4	10	1/2

4"	4	10	1/2
5"	4	10	1/2
6"	4	10	5/8
Based on MSS-69 & IMC.			

I. Support vertical runs at each floor.

J. Install steel natural gas piping with the following minimum rod size and maximum spacing. CSST support shall be in accordance with manufacturers installation requirements.**:**

Size (NPS)(Inches)	Maximum Span in Feet	Minimum Rod Size - Inches
1/2	6	3/8
3/4 to 1-1/4	8	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 5	10	5/8
Vertical, all sizes	Every floor level	

K. Provide copper or copper plated hangers and supports for copper piping or provide sheet lead packing between hanger or support and piping.

L. Place a hanger within 1-foot (0.305 m) of each horizontal elbow.

M. Use hangers which are vertically adjustable 1-1/2 inch (38.1 mm) minimum after piping is erected. Provide and tighten tap locking nut on each hanger.

N. Support vertical steel and copper piping at every story height but at not more than 15-foot intervals for steel and 10-feet for copper.

O. Where several pipes can be installed in parallel and at same elevation, provide trapeze hangers.

P. Where practical, support riser piping independently of connected horizontal piping.

Q. Each pipe drop to equipment shall be adequately supported. All supporting lugs or guides shall be securely anchored to the building structure.

R. Install all couplings with torque wrench, torqued to inch-pounds as specified by the manufacturer.

S. Hang all insulated pipe at the point of support in the following manner:

1. Hanger: See Paragraph 2.2.
2. All insulated pipes (≥ 2"d) shall have insulation protection saddles at all support points. All piping shall have thermal shield inserts at each penetration through wall, floor and roof.

3. Clevis Hangers: Install 180-degree waterproof, asbestos free, calcium silicate thermal shield insert with 180 degree galvanized steel protection shield.
4. Trapeze Hangers Utilizing Unistrut Clamps or U-Bolts: Provide 360 degree waterproof, asbestos free, calcium silicate thermal shield insert with 360 degree steel protection saddle.
5. All hangers shall be properly sized to accommodate the thermal shield insert and no hanger shall penetrate or crush any of the insulating material.

T. Install anchors and fasteners in accordance with manufacturer's recommendations and the following:

1. In the event a self-drilling expansion shield or machine bolt expansion shield is considered to have been installed improperly, the Contractor shall make an acceptable replacement or demonstrate the stability of the anchor by performing an on-site test under which the anchor will be subjected to a load equal to twice the actual load.
2. Powder-driven fasteners may be used only where they will be concealed after the construction is complete. Where an occasional fastener appears to be improperly installed, additional fastener(s) shall be driven nearby (not closer than six (6) inches) in undisturbed concrete. Where it is considered that many fasteners are improperly installed, the Contractor shall test load any fifty (50) successively driven fasteners. If 10 percent or more of these fasteners fail, the Contractor shall utilize other fastening means as approved and at no additional cost to the Owner.
3. Hangers for piping and ducts shall be attached to cellular steel floor decks with steel plates and bolted rod conforming to the steel deck manufacturer's requirements. Where the individual hanger load exceeds the capacity of a single floor deck attachment, steel angles, beams or channels shall be provided to span the number of floor deck attachments required.
4. Welding may be used for securing hangers to steel structural members. Welded attachments shall be designed so that the fiber stress at any point of the weld or attachment will not exceed the fiber stress in the hanger rod.

3.5 INSTALLATION OF PIPE EXPANSION CONTROL ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31.9, and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31.9 and with AWS Standards D1.1.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to control movement to compensators.

D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.6 SHEET METAL DUCT HANGERS AND SUPPORTS

A. Hanger Minimum Sizes:

1. Up to 30-Inch Wide: 1-inch x 16 gauge at 10-foot spacing.
2. 31-Inch to 48-Inch Wide: 1-1/2 inch x 16 gauge at 10-foot spacing.
3. Over 48-Inch Wide: Trapeze hangers with angle iron and 1/2-inch rods spaced not more than 8-foot on centers.
4. Up to 20" round: 1-inch x 20 gauge at 10-feet spacing.
5. Up to 60" round: I-inch 18 gauge at 10 foot spacing.

B. Horizontal Duct on Wall Supports Minimum Sizes:

1. Up to 18-Inch Wide: 1-1/2 inch x 16 gauge or 1-inch x 1-inch x 1/8 inch at 8-foot spacing.
2. 19-Inch to 40-Inch Wide: 1-1/2 inch x 1-1/2 inch x 1/8-inch angle at 4-foot spacing.

C. Vertical Duct on Wall Supports Minimum Sizes:

1. At 10-foot spacing.
2. Up to 24-Inch Wide: 1-1/2 inch x 16 gauge; 25-inch to 36-inch wide: 1-inch x 1-inch x
3.

D. Vertical Duct Floor Supports Minimum Sizes:
1. Riveted or screwed to duct.
2. Up to 60-Inch Wide: 1-1/2 inch x 1-1/2 inch x 1/8-inch angle.

E. Provide sway bracing on all ductwork in accordance with local codes and regulations.

3.7 SPIRAL LOCK SEAM DUCT HANGERS AND SUPPORTS

A. Round Duct Hangers Minimum Sizes:

1. At 10-foot spacings.
2. Up to 18-Inch Diameter: 1-inch x 16 gauge.
3. 19-Inch to 36-Inch Diameter: 1-inch x 12 gauge.
4. 37-Inch to 50-Inch Diameter: 1-1/2 inch x 12 gauge.

B. Vertical Duct Floor Supports Minimum Sizes:

1. Rivet to duct and tie angles together with road, angles or cinch band.
2. Up to 48-Inch Wide: 1-1/2 inch x 1-1/2 inch x 1/8-inch angle.

C. Additional Hanger Requirements:

1. 2-Inch to 24-inch from flexible connections of fans.
2. 2-Inch to 24-inch from the outlets or flexible connections of VAV control units or mixing boxes.
3. 12-Inch to 36-inch from the main duct to the first hanger of long branch ducts.

4. 2-Inch to 12-inch from the ends of all branch ducts and linear diffuser plenums.
5. 2-Inch to 24-inch from fire or fire/smoke damper break-away joints.
6. Hangers at throat and heal of round or square elbows 48-inch or greater in width.

3.8 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.

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 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and 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 that no roughness shows after finishing.

3.9 ADJUSTING

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

B. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces.

1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

[OR]

2. Touch-Up Painting: Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of the shop paint on miscellaneous metal is specified in Division 9 section "PAINTING" of these specifications.

C. For galvanized surfaces, clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 230529

SECTION 230553 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of Mechanical Identification Work required by this section is indicated on drawings and/or specified in other Division 23 sections.

B. Types of Identification Devices specified in this section include the following:

1. Painted Identification Materials
2. Plastic Pipe Markers
3. Plastic Duct Markers
4. Plastic Tape
5. Underground-Type Plastic Line Marker
6. Valve Tags
7. Valve Schedule Frames
8. Engraved Plastic-Laminate Signs
9. Plasticized Tags
10. Lettering and Graphics

C. Refer to other Division 23 sections for Identification Requirements at Central-Station Mechanical Control Center; not work of this section.

D. Refer to Division 26 sections for Identification Requirements of Electrical Work; not work of this section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), size of valve, and variations for

identification (if any). Only tag valves which are intended for emergency shutoff and similar special uses, such as valve to isolate individual system risers, individual floor branches or building system shut-off valves. In include in Operation & Maintenance Manuals as specified in Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Brady (W.H.) Co.; Signmark Division
2. Brimar Industries, Inc.
3. Industrial Safety Supply Co., Inc.
4. Seton Name Plate Corp.
5. Holbi.

2.2 MECHANICAL IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.3 PAINTED IDENTIFICATION MATERIALS

A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping or to match existing size in existing building, but not less than 1-1/4 inch high letters for ductwork and not less than 3/4-inch high letters for access door signs and similar operational instructions.

B. Stencil Paint: Standard exterior type stenciling enamel; Black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

C. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated, comply with ANSI A13.1 for colors or to match existing building standard identification.

2.4 PLASTIC PIPE MARKERS

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.

B. Insulation: Furnish 1-inch thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125

degree F (52 degree C) or greater. Cut length to extend 2-inch beyond each end of plastic pipe marker.

C. Small Pipes: For external diameters less than 6-inch (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one (1) of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4-inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inch.

D. Large Pipes: For external diameters of 6-inch and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than three (3) times letter height (and of required length), fastened by one (1) of the following methods:

1. Steel spring or non-metallic fasteners.
2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2 inch wide; full circle at both ends of pipe marker, tape lapped 3-inches.
3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

E. Lettering: Comply with piping system nomenclature as specified, scheduled, shown, or to match existing building lettering nomenclature system and abbreviate only as necessary for each application length.

F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.5 PLASTIC DUCT MARKERS

A. General: Provide manufacturer's standard laminated plastic, duct markers.

B. For Hazardous Exhausts, use colors and designs recommended by ANSI A13.1.

C. Nomenclature: Include the following:

1. Direction of air flow
2. Duct service (supply, return, exhaust, etc.)
3. Duct origin (from)
4. Duct destination (to)
5. Design CFM

2.6 PLASTIC TAPE

A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2 inch wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6-inch, 2-1/2 inch wide tape for larger pipes.

C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.7 UNDERGROUND-TYPE PLASTIC LINE MARKERS

A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6-inch wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried pipe.

B. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.8 VALVE TAGS

A. Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4-inch high letters and sequenced valve numbers 1/2-inch high, valve normal position 1/4-inch high letters, and with 5/32-inch hole for fastener.

1. Provide 1-1/2 inch diameter tags, except as otherwise indicated.
2. Fill tag engraving with Black enamel.

B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), and solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

C. Access Panel Markers: Provide manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8-inch center hole to allow attachment.

2.9 VALVE SCHEDULE

A. Valve Schedule shall be printed on company letterhead and shall include the following columns:

1. Valve Tag Number (*example*: HWS-1)
2. Service (*example*: ISOLATE AHU-1 HEATING COIL)
3. Room Number (location of valve)
4. Size of Valve
5. Type of Valve
6. Normal Position of the Valve (open or closed)

B. Provide 3-ring binder with project information labeled on outside for containment of valve tag schedule.

2.10 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, Black with White core (letter color) except as

otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/8-Inch, except as otherwise indicated.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.11 PLASTICIZED TAGS

A. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4 inch x 5-5/8 inch, with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (As examples; DANGER, CAUTION, DO NOT OPERATE).

2.12 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified, scheduled and approved by the Owner/Engineer. Provide numbers, lettering and wording as indicated and approved by the Owner/Engineer for proper identification and operation/maintenance of mechanical systems and equipment.

B. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as designated on the drawings or schedule as well as service.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK IDENTIFICATION

A. General: Identify air supply, return, exhaust, intake and relief ductwork and duct access doors with duct markers; or provide stenciled signs and arrows, showing ductwork service and direction of flow, in Black or White (whichever provides most contrast with ductwork color). Existing building identification shall match the existing method which exists in the building.

B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into

concealed enclosures (shaft, underground or similar concealment), and at 50-foot spacings along exposed runs.

C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment), other maintenance and operating instructions, and appropriate safety and procedural information.

D. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticized tags may be installed for identification in lieu of specified signs, at Installer's option.

E. Terminal Box remote identification on ceiling grid shall be provided directly below terminal using plastic laminate tag with plan code only.

3.3 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers of the following type on each system indicated to receive identification, and include arrows to show normal direction of flow. Existing building identification shall match the existing method which exists in the building.

B. Plastic pipe markers, with application system as indicated under "MATERIALS" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.

C. Stenciled markers, Black or White for best contrast, wherever continuous color-coded painting of piping is provided.

D. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

E. Provide identification labels on each ceiling grid or ceiling access door for control device and equipment located above ceiling.

F. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.

G. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.

H. At access doors, manholes and similar access points which permit view of concealed piping.

I. Near major equipment items and other points of origination and termination.

J. Spaced intermediately at maximum spacing of 25-foot along each piping run, except reduce spacing to 15-foot in congested areas of piping and equipment.

K. On piping above removable acoustical ceilings.

3.4 UNDERGROUND PIPING IDENTIFICATION

A. General: During back-filling/top-soiling of each exterior underground piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6-inch to 8-inch below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16-inch, install single line marker. For tile fields and similar installations, mark only edge pipelines of field.

3.5 VALVE IDENTIFICATION

A. General: Provide valve tag on valves in each piping system. List each tagged valve in valve schedule for each piping system.

1. Each individual system riser shutoff valves.
2. Each individual system floor shutoff valves.

B. Provide the following columns and information for each valve:

1. Valve Tag Number (*example*: HWS-1)
2. Service (*example*: ISOLATE AHU-1 HEATING COIL)
3. Room Number (location of valve)
4. Size of Valve
5. Type of Valve
6. Normal Position of the Valve (open or closed)

C. Mount valve schedule frames and schedules in mechanical equipment rooms where directed by Architect/Owner/Engineer.

3.6 MECHANICAL EQUIPMENT IDENTIFICATION

A. General: Install minimum 2-inch x 4-inch engraved plastic laminate equipment marker on each individual items of mechanical equipment. Provide signs for the following general categories of equipment.

1. Room thermostats, except gun tag labels are acceptable for room thermostats.
2. Fans and blowers.
3. VAV units.

B. Lettering Size: Minimum 1/4-inch high lettering for name of unit.

C. Text of Signs: In addition to the identified unit, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.7 ADJUSTING AND CLEANING

A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING & BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Divisions 1 and 23 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

A. This section covers Testing and Balancing of Environmental Systems including but not limited to air distribution systems, hydronic distribution systems, and the equipment and apparatus connected thereto. The testing and balancing of all environmental systems shall be the responsibility of one (1) testing, balancing and adjusting firm.

1. Test, Adjust, and Balance all of the following mechanical systems:

a. Supply Air Systems;
b. Return Air Systems;
c. Exhaust Air Systems;
d. Hydronic Systems;
e. Pumps;
f. Refrigeration Equipment;
g. Temperature Control System;

2. Report any systems for excessive sound and vibration levels.

1.3 QUALIFICATIONS OF CONTRACTOR

A. Procure the services of an independent testing and balancing Agency specializing in the testing, adjusting and balancing of environmental systems to perform the above mentioned work. An independent agency is defined as an organization that is not engaged in engineering design or is not a division of a mechanical contractor entity that installs mechanical systems. It shall be an agency certified by NEBB or TABB. Testing and balancing work shall be directly supervised by a NEBB certified Supervisor or Professional Engineer on the Testing and Balancing Agency's staff. The Supervisor shall represent the Testing and Balancing Agency in progress meetings as requested, and shall be available for interpreting all material found in the Balance Report.

1. All field work shall be performed by qualified technicians who are currently certified by either NEBB or TABB Test and Balance Certification Agencies.

1.4 CONTRACTOR QUALIFICATIONS REVIEW

A. The Mechanical Contractor shall submit the name of the Testing and Balancing Agency to the Architect within thirty (30) days of contract award to ensure that the Testing and Balancing Agency is on the project from the outset of construction.

B. Any testing and balancing agency desiring to offer their services for this Work shall submit their qualifications to the Architect, not less than seven (7) working days before the bid date. Review and recommendations to Owner will be given on each request and action on the recommendation will be given in writing prior to bidding the work. Agencies meeting the qualifications of the Specification are those Agencies approved by the Owner.

C. Acceptable TAB Agencies are:

1. Griffith Engineering Service
2. JPG Engineering, Inc.
3. TAB Services
4. L.H. Finn & Assoc.
5. Complete Mechanical Balancing, Inc.
6. Double T Balancing Company
7. Superior Balance and Commissioning, Inc.
8. Elite Balancing, Inc.

1.5 CODES AND STANDARDS

A. ASHRAE: ASHRAE Handbook 2011, Applications Volume, Chapter 36, Testing, Adjusting, and Balancing.

B. NEBB: "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems."

C. SMACNA: "Tab Procedure Guidelines".

1.6 SUBMITTALS

A. Upon award of the Contract, the Contractor shall submit the name of the Test and Balance Agency who will be performing the work. The submittal shall include a complete list of all technicians who will be performing the field work and include a photocopy of their current certification by either NEBB or TABB Certification Agencies.

B. Only those technicians included in the submittal shall perform the work. Any personnel or staff used to perform the work who are not included in the submittal shall be grounds for rejecting the Test and Balance Report and the Project in whole.

1.7 PROJECT CONDITIONS

A. Air and water testing and balancing shall not begin until the system has been completed and is in full working order.

B. Put all heating, ventilating and air conditioning systems and equipment into full operation and continue operation of same during each working day of testing and balancing. Preliminary Testing and Balancing requirements shall be ascertained prior to the commencement of work through a review of the project plans and specifications. In addition, visual observations at the site during construction shall be made to determine the location of required balancing devices, that they are being installed properly, and in an accessible location for the need. Report in writing any deficiencies to the Contractor and Mechanical Engineer immediately.

C. Before any air balance work is done, the system shall be checked for duct leakage, assure filters are installed, see that filters are changed if they are dirty, check for correct fan rotation, equipment vibration, and check automatic dampers for proper operation. All volume control dampers and outlets shall be wide open at this time.

D. Before any hydronic balancing work is done, the system shall be checked for plugged strainers, proper pump rotation, proper control valve installation and operation, air locks, proper system static pressure to assure a full system, proper flow meter and check valve installation. All throttling devices and control valves shall be open at this time.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate scheduling of Work with the Contractor.

1. Schedule TABB work to coincide with testing and verification of the temperature control systems where practical.
2. Coordinate system start-up and performance verification with the Engineer as TABB work is in progress.

B. Provide written notification to the Project Manager five (5) working days prior to commencing TABB and a schedule for completing the work.

C. Provide written notification to the Contractor within twenty-four (24) hours of an equipment failure preventing TABB work from proceeding.

PART 2 - PRODUCTS

2.1 INSTRUMENTS

A. Calibration and maintenance of instruments shall be in accordance with manufacturer's standards and recommendations and requirements of NEBB.

B. Calibration histories for each instrument shall be available for examination.

PART 3 - EXECUTION

3.1 TEMPERATURE CONTROLS

A. Operate all temperature control systems with the Temperature Control Contractor's representative for proper sequence of operation and calibration. Report in writing any deficiencies to the Engineer immediately.

3.2 REQUIREMENTS OF WORK

A. Provide all necessary fan belts and sheaves to balance all fans to the specified air delivery for the actual field conditions.

B. Balance all air and water flows at terminals within +5 percent to -5 percent of design flow quantities for individual terminals. And +10 percent to –5 percent of individual air outlets or inlets. Measure and record the following data:

C. Air Balance:

1. Air supply, return and exhaust systems with air quantities for each air device; air handling units including supply, return, mixed, and outside temperatures and fan data including CFM, static pressure, fan RPM, voltage, rated motor amperage, motor running amperage before and after final balance, listed motor power factor and motor running power factor reading. Air diffusion patterns shall be set to minimize objectionable drafts, noise, and local smoke detection device ratings.
2. The supply, return and exhaust fan static pressure shall be set by the balancing firm and the Control Contractor if the systems have fan volume control. The duct static shall be confirmed both through the instrumentation installed on the job and by the Balancing Agency. The system shall be tested in all operating modes (including minimum outside air with full return air, full outside air, modulated damper position, and full cooling with the design diversity). System static pressure and fan motor amperages shall be recorded in all modes. The fan speed resulting in satisfactory system performance shall be determined at full design delivery, inlet or outlet fan. Volume control dampers shall be in the wide open position and variable frequency drive is at 100 percent of design RPM and one (1) path presenting the greatest resistance to flow shall be fully open and unobstructed.
3. Provide full pitot traverse and CFM measurements at each fan in addition to terminal device measurements.
4. Air volume and air temperature rise or drop across each coil, filter, dampers, etc., of air handling section.
5. Measure, adjust, set, balance and record outside air, return air and exhaust/relief air quantities for all air handling systems and supply fans.

Air quantities shall be determined by direct airflow measuring procedures wherever possible, where duct/inlet conditions do not allow for accurate direct measurement of outside air the following method shall be used:

Outside Air CFM = Supply Fan Total CFM

-Return Fan Total CFM

In addition to the direct measuring of airflow quantities, measure and record outside air, return air and mixed air temperatures, determine thermal/mass energy balance and provide calculations to verify measured airflow quantities. Adjusting and setting the outside air quantity as a percentage of damper position will not be acceptable.

D. Final adjustments shall include but not be limited to the following:

ITEM	**ADJUSTMENT**
Fan: Belt Drive	RPM. Include sheave and belt exchange to deliver air flow within limits of installed motor horsepower and mechanical stress limits of the fan. Determine the limiting fan tip speed before increasing RPM. Final fan speed setting shall allow for predicted filter loading and shall establish proper duct pressures for operation of zone CFM regulators.
Fan: Direct Drive	RPM with speed taps. Set fan speed on tap which most closely approaches design CFM. Report tap setting on equipment data sheet as high, medium or low. RPM with speed control rheostat. Set output of fan at design CFM by adjusting the SCR. After adjustment, check fans ability to re-start after powering down. Increase setting if required for proper starting. CFM with variable pitch blades. Variable fixed pitch fan blades and variable in motion pitch fan blades shall be adjusted by the manufacturer at pitch required to provide design output. Pitch angle adjustment shall not exceed recommended maximum to prevent "stall."
Terminal Boxes	VAV and Constant Volume Boxes with Reheat. Set regulators to provide design maximum, minimum, heating and cooling CFM. VAV Boxes: Set volume at 100 percent maximum and 30 percent **[___ percent]** minimum of design CFM. Check control sequence operation to assure proper sequencing. Reset PE switches as required when furnished with terminal box. Fan powered boxes with reheat. Set CFM regulators and control sequence as for VAV reheat. Set fans as for direct drive with speed tap or with SCR.
Air Devices	All diffusers and registers shall be measured and balanced.

E. Hydronic Balance:

1. Convertor inlet and outlet water temperatures and pressures with corresponding system steam pressure or heating water temperatures and pressures.
2. Inlet and outlet water temperatures and pressures (or system steam pressure) of all air handling unit coils, reheat coils, unit heaters, convectors, finned tube radiation, and other heat transfer equipment, as well as the corresponding media flows, and air temperature rise or drops.
3. Circulating pump flow rates, pressures, running amperage, and full load amperage at design flow and shutoff conditions.
4. The hydronic system shall be proportionally balanced being certain that the path to one (1) terminal is fully open. Total system flow shall be adjusted at the pump by restricting the discharge balancing valve. If the pump must be severely restricted, the impeller may have to be trimmed. This decision will be the responsibility of the Contractor, Supplier, and the Mechanical Engineer.

F. When necessary as determined by the Mechanical Engineer, the Test and Balance Agency shall provide additional testing and measurements as required by the Mechanical Engineer including, but not limited to, the following:

1. Static pressure gradient profiles throughout ductwork and/or piping systems.
2. Temperature gradient profiles throughout ductwork and/or piping system.
3. Miscellaneous electrical measurements.
4. Smoke tests of room pressure relationships.
5. This work shall be done immediately upon request with complete cooperation and in an expedient schedule at no additional cost to any other party.

3.3 REPORT OF WORK

A. The Testing and Balancing Agency shall submit six (6) bound copies of the final Testing and Balancing Report at least five 5 calendar days prior to the Contractor's request for final inspection. All data shall be recorded on applicable reporting forms. The report shall include all operating data as listed in Paragraph 3.2 above, a list of all equipment used in the testing and balancing work, and shall be signed by the Supervising Registered Professional Engineer and affixed with their registration stamp, signed and dated in accordance with State Law. Final acceptance of this project will not take place until a satisfactory report is received.

B. When deemed necessary by the Mechanical Consulting Engineer, the Testing and Balancing Agency shall run temperature and/or humidity recordings and shall read any of the report quantities in the presence of the Engineer for verification purposes.

C. When all air balancing is done and all dampers are set, all test holes shall be plugged and all dampers shall be marked with paint. The following information shall be recorded for each fan system in the final report: Design fan and air device inlet or outlet size, actual inlet or outlet size, design and actual CFM and velocity through the orifice, for each terminal in the system. The pitot tube traverse method used and location of pitot tube traverse for determining CFM shall be recorded.

D. Hydronic Systems With Meters: The system shall be balanced proportionally using the flow meters. On completion of the balance, the following information shall be recorded in the report: Flow meter size and brand, required flow rate and pressure drop, valve settings on meters with a readable scale, flow rate in both full coil flow and full bypass modes. Verify the meters are installed per the manufacturer's recommendations and shall notify the Contractor of any deficiencies before utilizing meter.

E. Hydronic Systems without Meters (Thermal or Terminal Rated Pressure Drop Balance): The system shall be balanced proportionally to the terminal ratings. On completion of the balance, the following information shall be recorded in the report: Design entering and leaving water temperature/pressure drop, final balanced entering and leaving water temperature/pressure drop.

F. When all hydronic balancing is done, all valves shall be marked or the locking rings set. Control valve bypass loops shall be set with the balancing valve to provide equal flow in either mode. Confirm in writing this work has been completed.

G. After all balancing is complete and all coordination with the Contractor and the Engineer is complete, the balancing firm shall furnish aforementioned bound report which shall contain the following information:

1. RPM, drive sheave information (as installed and as changed), fan nameplate information, motor nameplate information, motor amperage, motor voltage and power factor to all motors (in all operating modes).
2. Static pressure across all components of the system.
3. Required and final balanced CFM at each system terminal. Include the terminal size, reading orifice size, and velocities read to attain the CFM.
4. Indicate on which terminal (on each system) has been balanced 100% open as required in the previous sections for both air and hydronic balancing.
5. The report shall include a sheet which shall report the method of balance, project altitude, and any correction factors.
6. A **complete** reduced set of the **Black-line** Mechanical Contract Drawings which shall be included in the report with all equipment, flow measuring devices, terminals (VAV boxes, outlets, inlets, coils, unit heaters, schedules, etc.) clearly marked and all equipment designated.
7. Include in the report all variable frequency drive electrical performance test characteristics for each motor as described in this specification section. Include photocopies of all meter chart recorded <measured data> and/or computer printed output.

H. The Testing and Balancing Agency shall respond and correct all deficiencies within seven (7) days of receiving the Engineer's written review of the Balancing Report. Failure to comply will result in holding retainage of the final payment until all items have been corrected to the satisfaction of the Engineer.

3.4 GUARANTEE OF WORK

A. The Testing and Balancing Agency shall guarantee the accuracy of the tests and balance for a period of ninety (90) days from date of final acceptance of the Test and Balance Report. During this period, the Testing and Balancing Agency shall make personnel available at no cost to the Owner to correct deficiencies that may become apparent in the system balance.

END OF SECTION 230593

SECTION 230700 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This Section includes:

1. Piping Insulation and Accessories
2. Ductwork Insulation and Jackets

B. Refer to other Division 23 sections for Shields, Inserts, and Mechanical Identification.

C. [**Insulation thickness based on ASHRAE 90.1 recommendations. Ductwork insulation thickness is based on Table 6.2.4.2B, Envelope Criteria Table 5-16 through 5-19 for Exterior, Unvented Attic With Roof Insulation, Unconditioned Space and Indirectly Conditioned Spaces. Piping insulation thickness is based on Table 6.2.4.5.**]

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than three (3) years.

B. Installer's Qualifications: Firm with at least five (5) years successful installation experience on projects with mechanical insulations similar to that required for this project.

C. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics and insulating cements.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's installation instructions and schedule listing materials, thickness, K-value, density, and furnished accessories for each service or equipment specified.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard ratings of the products, name of manufacturer, and brand.

B. Protect insulation against dirt, water, chemical, and mechanical damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide product by one of the following:

1. Insulation:

a. Armstrong World Industries, Inc. (flexible elastomeric)
b. Johns-Manville Products Corp. (fiberglass, calcium silicate)
c. Knauf Fiber Glass (fiberglass)
d. Manson Insulation Co. (fiberglass, calcium silicate)
e. Owens-Corning Fiberglas Corp. (fiberglass)
f. Rubatex Corp. (flexible elastomeric)
g. Aeroflex (flexible elastomeric)
h. Roxul (Mineral Wood)

2. Jacketing, Coatings, Adhesives, Sealants and Covering Products:

a. Childers
b. Foster
c. Ceel-Co.
d. Johns-Manville Products Corp.
e. Knauf Fiber Glass
f. Venture Tape Corporation
g. Design Polymetrics

2.2 PIPING INSULATION

A. Glass Fiber: ASTM C 547, Type 1, rigid molded, noncombustible, 0.23 "K" value at 75 degree F mean temperature, maximum service temperature 850 degree F, moisture sorption less than 0.2% by volume. Composite 25/50-flame spread/smoke developed rating (ASTM E 84, UL 723, and NFPA 255).

1. Vapor Retarder Jacket: ASTM C 1136, 45lbs/in tensile strength (ASTM D 828), or beach puncture 50 oz in/in tear minimum (ASTM D 781). White Kraft paper reinforced with glass fiber yarn and bonded to aluminum foil, secured with self-sealing longitudinal laps and butt strips.
2. Connections: Tacks, pressure sensitive color matching vinyl tape, Perma-Weld adhesive.

B. Calcium Silicate: ASTM C 533, Type I, rigid molded, noncombustible (ASTME E 136), 0.42 "K" value at 300 degree F mean temperature, maximum service temperature 1200 degree F, 160 psi compressive strength for 5 percent compression (ASTM C 165), flexural strength 70 psi (ASTM C 203). 0/0 flame spread/smoke developed rating (ASTM E 84).

1. Tie Wire: 16-Gauge stainless steel with twisted ends on maximum 12-inch centers.

C. Mineral Wood: ASTM C 547, Type 1, Type IV, molded, 0.34 K value at 300 degree F mean temperature, maximum service temperature 1000 degree F, moisture sorption less than 0.2% by volume. Composite 25/50-flame spread/smoke developed rating (ASTM E 84, UL 723, and NFPA 255).

1. Vapor Rertarder Jacket: ASTM E 96, 68lbs/in tensile strength (PSTC-31). 5-ply weather and abuse resistant jacketing, secured with self-sealing longitudinal lap.

D. Field Applied Fittings and Jackets:

1. PVC Plastic:

a. One-piece, gloss white, molded fitting covers with factory installed fiberglass insulation inserts.
b. 20 Mil (30 mil for exterior applications) cut and curled gloss white jacketing material. Composite 25/50 flame spread/smoke developed rating (ASTM E84, UL 723 and NFPA 90A).
c. Connect with tacks and pressure sensitive color matching vinyl tape.

2.3 DUCTWORK INSULATION

A. Flexible Fiberglass Blanket: ASTM C 553, Type II, 3/4 lb/cu ft density, 1-1/2 inch thickness, 0.27 "K" value at 75 degree F mean temperature at compressed thickness, maximum service temperature 250 degree F, moisture sorption less than 0.2% by volume, aluminum foil facing reinforced with fiberglass scrim laminated to UL rated Kraft paper. Composite 25/50-flame spread/smoke developed rating (ASTM E 84, UL 40, and NFPA 90A).

1. Secure with UL Listed pressure sensitive tape and/or outward clinched expanded staples and vapor barrier mastic as needed.

B. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

C. Ductwork Insulation Coating, Mastics, Adhesives and Sealants:

1. Vapor Barrier Coating (Store and apply between 40°F and 100°F, protect from freezing until dry): Used on below ambient piping/duct to prevent moisture ingress. Permeance shall be 0.013 perms or less at 43 mils dry per ASTM E 96, Procedure B.

a. Foster 30-80
b. Childers CP-38
c. Vimasco 749

2. Weather Barrier Mastic (Store and apply between 40° F and 100° F, protect from freezing until dry): Used on above ambient piping/duct outdoors.

    a. Fosters 46-50
    b. Childers CP-10/11
    c. Vimasco WC-5

3. Lagging Adhesive/Coating (Store and apply between 40° F and 100° F, protect from freezing until dry): Comply with MIL-A-3316C, Class 1, Grade A.

    a. Foster 30-36
    b. Childers CP-50AHV2
    c. Vimasco 713

4. Fiberglass Adhesive (Store and apply between 40° F and 100° F, protect from freezing until dry): Comply with ASTM C916, Type II.

    a. Foster 85-60
    b. Childers CP-127
    c. Vimasco 795

5. Metal Jacketing/Flashing Sealant (Store and apply between 40° F and 100° F, protect from freezing until dry): Used to seal metal jacketing laps against water entry and to flash penetrations.

    a. Foster 95-44
    b. Childers CP-76
    c. Pittsburgh Corning PC 727

6. Reinforcing Mesh: Used in conjunction with coatings and mastics.

    a. Foster Mast a Fab
    b. Childers Chil Glas #10
    c. Vimasco Elast a Fab

7. Self-Adhesive Indoor/Outdoor Jacket (Non Asphaltic): Vapor barrier and waterproofing jacketing for installation over insulation located aboveground outdoors or indoors. Specialized jacket with five layers of laminated aluminum and polyester film with low temperature, acrylic, pressure sensitive adhesive; outer aluminum surface coated with UV resistant coating for protection from environmental contaminants. Permeance: 0.00 perm as tested by ASTM F 1249. Flame Spread <25, Smoke Developed <50 tested by ASTM E-84. Aluminum finish. [**Embossed**][**Smooth**]

D. Round Ducts and Concealed Rectangular Ducts: Adhere flexible insulation to ductwork with adhesive applied in 6-inch wide strips on 16-inch centers. Butt insulation and seal joints and breaks with 2-inch lap of foil adhered over joint.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions where mechanical insulation is to be installed. Do not proceed until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 HVAC PIPING INSULATION (Based 2015 IECC)

A. Hot Low Pressure Piping (141° F to 200° F (121 Degree C):

1. Applications:

   a. Heating water supply and return.

2. Insulation:

   a. Fiberglass: 1-1/2 Inch thickness up to 1 1/2" inch pipe, 2-inch thickness for all other pipe sizes.
   b. Fiberglass for runouts up to 2-inch, 1-inch thickness.

3.3 DUCTWORK INSULATION

A. Flexible Fiberglass Blanket:

1. Concealed supply ductwork without liner: 1-1/2 Inch thickness. (IECC R5 min)
2. Return ductwork in unconditioned spaces without liner: 1-1/2 Inch thickness. (IECC R5 min)
3. Exhaust ductwork within 10 ft. of exterior opening without liner: 1-1/2 Inch thickness.

3.4 INSTALLATION OF PIPING INSULATION

A. Install insulation after piping system tests have been completed.

B. Clean piping to remove foreign substances and moisture prior to applying insulation.

C. Install insulation products according to manufacturer's written instructions, building codes, and recognized industry standards.

D. Omit insulation on air chambers, unions, balance cocks, flow regulators, buried piping, and pre-insulated equipment.

E. Omit insulation on hot piping within radiation enclosures or unit cabinets; on cold piping within unit cabinets provided piping is located over drain pan; on heating piping beyond control valve, located within heated space; on condensate piping between steam trap and union; and on unions, flanges, strainers, flexible connections, and expansion joints.

F. Secure longitudinal jacket laps and butt strips according to manufacturer's recommendations.

G. Firmly rub lap and butt strips to pressurize seam and ensure positive closure.

H. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use scraps.

I. Apply insulation to piping with all joints tightly fitted to eliminate voids.

J. Apply insulation on cold surfaces with a continuous, unbroken vapor seal. Hangers, supports, and anchors that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation. Seal pipe terminations in chilled water or glycol systems every four (4) pipe sections with vapor barrier coating.

K. Extend surface finishes to protect all surfaces, end, and raw edges of insulation.

L. Protect vapor-barrier jackets on pipe insulation from puncture or other damage. Avoid the use of staples on vapor barrier jackets. Seal vapor barrier penetrations with vapor barrier coating.

M. Cover valves, fittings and similar items with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded or job fabricated covers (at Installer's option). Coat all below ambient valves, fittings and similar items with vapor barrier coating and reinforcing mesh before application of PVC covers.

N. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where fire-stopping materials are required.

O. Provide thermal shield inserts on all pipe (Refer to 230529). For piping below ambient temperature, apply vapor barrier lap cement on butt joints and seal with 3-inch wide vapor barrier tape.

1. Minimum insulation insert lengths:

    a. 1-1/2 – 2-1/2 Inch Pipe: 10-Inches
    b. 3 – 6-Inch Pipe: 12-Inches
    c. 8 – 10-Inch Pipe: 16-Inches
    d. 12-Inch and Larger Pipe: 22-Inches

P. Apply galvanized metal shields between hangers or supports and pipe insulation. Form shields to fit the insulation and extend up to the centerline of the pipe. The shield length shall be 4-inches less than the associated insulation hanger insert to allow for vapor retarding butt joints on each side of the shields.

Q. Apply adhesives, mastics and coatings at manufacturer's recommended minimum coverage per gallon.

R. Replace all damaged insulation in whole; Repair of damaged insulation will not be accepted.

S. Insulate fittings and valves with PVC insulated fitting covers and insulation inserts per manufacturer's recommendations.

T. Install aluminum jacket on exterior piping.

1. Install metal jackets by overlapping seams 2-inches and securing with metal bands on 24-inch centers. Caulk all seams with 1/8" Bead of metal jacketing sealant. Locate longitudinal seams at the bottom of piping. Finish elbows and tees with matching metal fitting covers. Finish other fittings with conventional weather insulation materials with aluminum finish.

3.5 INSTALLATION OF DUCTWORK INSULATION

A. Install insulation products according to manufacturer's written instructions, building codes, and recognized industry standards.

B. Do not insulate fiberglass ductwork or lined ductwork.

C. Clean ductwork to remove foreign substances and moisture prior to applying insulation.

D. Apply insulation to ductwork with all joints tightly fitted to eliminate voids

E. Seal all vapor retardant jacket seams and penetrations with UL listed tapes or vapor retardant adhesive as recommended by the manufacturer. Coat all seams, breaks, tape patches and penetrations with vapor barrier coating.

F. Secure insulation to the underside of duct 24-inches or greater with mechanical fasteners or speed clips spaced 18-inches on center. Cut off protruding ends of fasteners after speed clips are installed and seal penetration of vapor barrier.

G. Extend ductwork insulation without interruption through walls, floors and similar penetrations, except where fire-stopping materials are required.

H. Install aluminum jacket on exterior ductwork insulation when not lined. Follow and comply with the jacketing manufacturer's installation guidelines.

I. Install corner angles on all external corners of insulation in exposed finished spaces before covering with jacketing.

J. Adhere flexible elastomeric sheets to ductwork by compression fit and full coverage of adhesive. Seal butt joints with same adhesive. Apply the same sheet thickness on standing metal duct seams as installed on the duct surface.

K. Jacket outdoor rigid insulation with Flexible Jacketing Membrane as specified. All longitudinal and circumferential seams must be overlapped a minimum of 3" (75mm). Ensure complete contact at the laps and to the substrate using a tape squeegee or roller applying firm pressure throughout. Install in strict accordance with manufacturer's guidelines.

3.6 EXISTING INSULATION REPAIR

A. Repair damaged sections of existing mechanical insulation, damaged during this construction period and within 3 ft of new connections.

B. Provide unit price to repair existing mechanical insulation on piping.

END OF SECTION 230700

SECTION 230800 - MECHANICAL COMMISSIONING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Purpose:
   1. Verify operation and functional performance of Central Mechanical HVAC Systems, Controls and Electrical Systems for compliance with "Design Intent", as defined by the Contract Documents.
   2. Document Mechanical and Electrical System test and inspections.
   3. Verify application of Operation and Maintenance Manuals, As-Built (Record) Documents, spare parts lighting, special tools, controls and other items as may be specified herein for support of Mechanical and Electrical Systems and Equipment.
   4. Provide indirect support of the training of personnel for operation and maintenance of Mechanical and Electrical Equipment and Systems.

B. General:
   1. Furnish labor and material to accomplish complete Mechanical and Electrical System Commissioning as specified herein. Complete interim commissioning of HVAC Systems during initial season operation.

C. Job Conditions: The Commissioning Contractor shall become familiar with the contract documents, all addenda, and change orders issued for this project prior to commencing the commissioning work.

1.2 QUALITY ASSURANCE

A. Reference: ASHRAE Guideline 1P, "Guideline for Commissioning of HVAC System".

B. Qualifications: The "Commissioning Authority" shall be defined as a company or agency of experienced personnel, qualified to plan and carry out the overall commissioning progress. The Commissioning Authority shall submit for Owner review, an outline of the organization's personnel qualification resources, commissioning, documentation process and commissioning plan specifically prepared for this project.

1.3 DOCUMENTATION

A. The Commissioning Authority shall obtain the following:
   1. Project Plans and Specification (Contract Documents), Authorized Revisions, Shop Drawings and Submittals (approved), Test and Balance Report, Equipment Start-Up and Certification Reports, Operation and Maintenance Manuals, etc.
   2. Records of required Code Authority Inspections, Contractor Test Inspections, Documentation Sign-Offs, etc.

1.4 SUBMITTALS

A. Commissioning Authority will submit the name of the Commissioning Project Manager approval prior to starting the commissioning process.
   1. Commissioning Plan (Describe extent and delivery schedule.)
   2. Commissioning Outline Plan (Describe extent of plan, expected duration of observations, personnel involved, schedule, etc.)
   3. Tool List: Provide a detailed list of the tools required for the commissioning process.

1.5 RESPONSIBILITIES OF OTHERS: Applicable specification sections outline trade responsibilities during the commissioning process.

A. General Contractor:
   1. General Contractor shall verify completeness of the building envelope, perimeter and interior items which effect proper operation and control of HVAC equipment and systems.
   2. The General Contractor will assure participation and cooperation of specialty contractors (Mechanical, TAB, Building Automation System, etc.) under his jurisdiction as required for the commissioning process.

B. Contractors Specialty:
   1. Individual Mechanical and Electrical Sub-Contractors will be responsible for providing labor, material, equipment, etc., required within the scope of this specialty to facilitate the commissioning process. The listed Sub-Contractor will perform tests and verification procedures required by the commissioning process when requested by the Commissioning Authority and directed by the General Contractor.

C. Owner/Operator:
   1. Owner/Operator may schedule personnel to participate in commissioning process.
   2. Owner/Operator will advise the Commissioning Authority regarding changes in building occupancy, usage, or functional requirements.

PART 2 - PRODUCTS

2.1 INSTRUMENTATION

A. Instrumentation will be provided by agency performing prior tests. Instruments will be operated by individual agency requested by the Commissioning Authority, as specified elsewhere herein.

PART 3 - EXECUTION

3.1 GENERAL

A. Commissioning Authority will participate in the Final Construction Phase of the Project to assure compliance with specific Commissioning Requirements.

3.2 PROCEDURE

A. Attend Construction Meeting and establish requirements for the Commissioning Process throughout Construction Phase.

B. Prepare and submit to the Owner's representative, **Seth Jacobs, Boulder County** after contract award, a Commissioning Plan which shall outline:
   1. Responsibility of each trade affected by Commissioning as required by appropriate section of this specification.
   2. Requirement for documentation as listed elsewhere herein.
   3. Requirements for documentation of tests and inspections required by Code Authorities.
   4. Requirements for the Commissioning Program during specified operational seasons, part and full loads as further delineated in PART 3.3.

C. Periodically attend construction and coordination meetings.

3.3 MECHANICAL SYSTEMS COMMISSIONING

A. Mechanical System Commissioning shall begin after HVAC equipment and systems, along with related equipment, systems, structures and areas are complete.

B. Verify TAB Readings, such as:
   1. Supply and Return Air CFM Quantities
   2. Fan Performance
   3. Hydronic Performances
   4. Branch Duct Readings
   5. Refrigeration Side Performance

C. Verify calibration of thermostats and related controls, such as:
   1. VAV Boxes
   2. Valve Positions
   3. Damper Position

D. Verify readings of remote data and control systems, such as:
   1. Temperature
   2. Air Flow
   3. Damper Positions
   4. Water Pressure
   5. Water Temperatures

E. Verify operation of system modes, such as economy cycle, smoke removal and in specific:
   1. Damper and Fan Operation
   2. Smoke Detector Response
   3. Zone Response

F. Verify that total HVAC System is performing to provide conditions as outlined in the Contract Documents, including seasonal, part and full load conditions.

COMMISSIONING CHECKLIST

The following Commissioning Checklists are provided to illustrate the minimum information which should be included in the Commissioning Checklist Final Report.

COMMISSIONING CHECKLIST - VAV DEVICES AND DUCTWORK

1. Prior to Functional Performance Test:
   a. All VAV boxes are in place, ducted, connected to controls system, heating boxes connected to electrical circuits with local disconnects mounted.
   b. Ductwork complete, as-built shop drawings submitted, duct pressure and leakage test complete.
   c. Duct Static Pressure Sensor installed, calibrated and transmitting 4-20 MA signal to fan speed controller. DDC controls system operational with input/output from each VAV box and thermostat verified, local controller functional and monitoring CRT functional.
   d. Smoke/Fire Dampers installed as required with access; verify status as to open/closed position.
   e. Test and Balance Operation is complete including each VAV box calibrated for maximum/ minimum flow settings, low pressure duct and devices balanced at maximum flow conditions, heating VAV boxes fan speed setting/air flow adjusted.

2. Personnel present during demonstration:
   a. General Contractor and Mechanical, Controls and Electrical Contractor
   b. Commissioning Authority
   c. Owner's Representative

3. Functional Performance Test: Contractor shall demonstrate operation of VAV boxes, as per specifications, including the following:
   a. Cooling/Heating VAV Boxes: With system as described above, perform all cooling only tests at noted. In addition, for space heating requirement demonstrate the following:
      1) VAV Box response to room temperature setpoint adjustment at local controller and CRT. Changes to be 78 degree F to 68 degree F, 72 degree F and 82 degree F.
         a) Check damper maximum/minimum flow settings.
         b) Verify damper actuator response to control input changes and rate of response. Record room temperature change, rate of change and overshoot/ undershoot of desired temperature.
   b. VAV Box response to sensor call for heating via setpoint adjustment, local controller and CRT changes. Changes to be warm-up from 55 degree F to 68 degree F, from 68 degree F to 74 degree F. Verify cooling damper closes to minimum position, fan energized to circulate air, and upon further drop in space temperature (T-stat adjustment acceptable), verify hot water reheat activation, deactivation, and shutoff on loss of air flow. Loss of air flow to be demonstrated by interrupting interlock or manual air vane flow sensor adjustment. Record room temperature change, rate of change and overshoot/undershoot of setpoint temperature.

4. Results:
   a. The Commissioning Authority shall report results obtained in Item 3. above.
   b. If specified equipment performance is not verified, the Commissioning Authority shall report remedial action required and re-schedule Functional Performance Test.

5. Reports:
   a. Submit reports of Functional Performance Test in Item 3. above to Architect.

COMMISSIONING CHECKLIST - BAS CONTROLS SYSTEM

1. Prior to Functional Performance Test:
   a. All control devices are in place, operable, calibrated, and communicating with local control panels and operator interface terminal communicating with local control panels and operator interface terminal (CRT).
   b. Test and verify power supplies, wiring, low voltage transformers, allowable voltage drops, and related interlocks are available and meet specifications. Continuity has been checked.
   c. Verify that control software programs have been loaded, edited and operational.
   d. Controlled devices, mechanical equipment, actuators, and sensors are complete and operable.
   e. Interrupt building power supply for thirty (30) minutes, re-energize, verify software packages and programming remained intact and operable after interruption.

2. Personnel present during demonstration:
   a. General, Mechanical, Electrical, and Controls Contractor
   b. Commissioning Authority
   c. Owner's Representative

3. Functional Performance Test: Contractor shall verify operation of the controls system, as per specification, and the following:
   a. Sensing Element: Verify wall mounted sensing elements are located per plans, securely mounted on wall with protective cover. Furnish plans, securely mounted on wall with protective cover. Furnish calibrated digital thermometer 40-105 degree F + 0.5 degree F accuracy to verify reporting temperature of each sensing element. At each sensing element, compare temperature sensed vs. actual temperature. Query each sensing element from local control panel and CRT; allowable variance is 0.5 degree F from digital thermometer.
   b. Follow procedure described in Item a. above for all temperature-sensing devices.
   c. VAV Box Controllers, refer to demonstration procedure in VAV Section.
   d. In each VAV Control Zone, reset setpoint from 72 degree F to 60 degree F, then record time to achieve setpoint (as climatic conditions and internal loads permit).
   e. Night Setback (as climatic conditions allow): Verify heating VAV boxes operate to maintain 55 degree F space temperature.
   f. Morning Warm-Up Cycle: Verify warm-up time, trend logging function, and reset of warm-up time at different ambient conditions, i.e. 50 degree F ambient and 30 degree F.
   g. Air Handling Unit: Refer to demonstration procedure in applicable section. At CRT, reset leaving air temperature setpoint, log response of multizone AHU's zone control valves, space temperatures, VAV box reactions, and system flow in system.
   h. Chiller/Cooling Tower/Pumps: Log chiller load and leaving water temperature as a result of resetting chilled water setpoint from 45 degree F to 50 degree F.
   i. For all controls Functional Performance Test, prepare report in format as follows:

      Binary Points (per specified points list):

      1)

Verify	YES	NO
Command Issued	___	___
Command Accepted	___	___
Command Executed	___	___
Controlled Device Responded	___	___
Feedback Verified Response	___	___

Analog Points (per specified points list):

2) Verify	YES	NO	INITIAL* STATUS	FINAL* STATUS
Command Issued	___	___	_____	_____
Command Accepted	___	___	_____	_____
Command Executed	___	___	_____	_____
Controlled Device Responded	___	___	_____	_____
Feedback Verified Response	___	___	_____	_____

*Status/Readings to be reported as follows:
Control Signal
Actual System Effect: Air flow, temperature, pressure, etc.

For interlocked devices, positioners, multiple points of control for each command, list effect and response on all devices.

4. Results:
   a. The Commissioning Authority shall report results obtained in Item 3 above.
   b. If specified equipment performance is not verified, Commissioning Authority shall report remedial action required and re-scheduled Functional Performance Test.

5. Reports:
   a. Submit reports of Functional Performance Test in Item 3 above to Architect.

END OF SECTION 230800

SECTION 230900 – DIRECT DIGITAL CONTROL SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. ***Boulder County will perform procurement and installation of all items within this specification section. This Specification Section has been included for the sole information of the building owner, Boulder County.***

B. Provide an extension to the Andover direct-digital control (DDC) system per the project documents, point list, interoperability tables, drawings and specifications. Include all engineering, programming, controls and installation materials, installation labor, commissioning, start-up, training, final project documentation and warranty.

1. The DDC system shall consist of high-speed BACnet IP, peer-to-peer network of DDC controllers.
2. The direct-digital control system shall be native BACnet. All new work stations, controllers, devices and components shall be listed by BACnet Testing Laboratories (BTL) with accessibility using a Web browser interface, and shall communicate exclusively using the ASHRAE Standard 135 BACnet communications protocol without the use of gateways, unless otherwise allowed by this Section of the technical specifications and specifically shown on the design drawings.

    a. If used, gateways shall support the ASHRAE Standard 135 BACnet communications protocol.

3. The work administered by this Section of the technical specifications shall include all labor, materials, special tools, equipment, enclosures, power supplies, software, software licenses, project specific software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, submittals, testing, verification, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, warranty, specified services and items required for complete and fully functional controls systems.

4. The control systems shall be designed such that each mechanical system shall operate under stand-alone mode. The contractor administered by this Section of the technical specifications shall provide controllers for each mechanical system. In the event of a network communication failure, or the loss of any field controller, the control system shall continue to operate independently. Failure of the operator work station(s) (OWS) shall have no effect on the field controllers, including those involved with global strategies.

C. The Contractor shall become aware of the Commissioning requirements outlined in Specification Section 230800. Change orders shall not be considered for time associated with these requirements.

D. The Contractor shall become aware of the Method of Procedure requirements outlined in Division 1. Change orders will not be considered for time associated with Method of Procedure requirements.

E. General: The Control System Contractor shall provide a complete new control system using new control devices to replace existing devices to operate as specified. The Contractor shall inspect the existing conditions prior to submitting a proposal. The existing temperature control system devices, dampers, operators, wiring, conduit, air piping, valves, etc., not being modified and which are no longer utilized, shall be removed, and not abandoned in place.

F. The Control System for this project will be referred to as a Building Automation System (BAS).

G. Total quantity and type of control points shall consist of specifications, drawings and as required to complete the Sequence of Operation as specified. Additional points shall be provided as required to meet all operational functions, safeties, monitoring and reporting requirements. The Drawings and Specifications are not intended to show all details necessary to make the system complete and operable.

H. The BAS shall include all control devices, valves, interlocks, field devices, hardware, software, automatic dampers, piping, fittings, wire, conduit, etc., as specified, required and connected so as to perform all functions and operate according to the specified sequences.

I. The Contractor shall leave operable existing controls in operation until the BAS is tested and proven operative. At that point, and with concurrence from the Owner and the Engineer, the Contractor shall be responsible for removing existing controls which are no longer necessary. Start-up of the BAS system, and any installation work that requires the interruption of the normal operation of any piece of equipment, shall be scheduled with the Owner. If the interruption of the normal operation of any piece of equipment during normal working hours is unacceptable to the Owner, then it shall be scheduled during after hours (night or weekend).

    1. The premium labor costs associated with off-hour work shall be included as part of the contract. Change orders for off-hour work will not be considered.

J. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner or Engineer in writing. Unless approved otherwise, all products (including firmware revisions) used in this installation shall have been used in at least twelve (12) projects prior to this installation. The previous sites may be located anywhere in the U.S.A. This requirement is not intended to restrict the Contractor to the use of any outdated equipment. Therefore, all products used in this installation shall also be currently under manufacture and have available, for at least ten (10) years after completion of the contract, including spare parts, board repairs and software revisions. If the above requirements are mutually exclusive, the Contractor shall include a specific statement to this effect in the Bid.

K. Refer to other Division 23 sections for installation of instrument wells, valve bodies and dampers in mechanical systems.

L. Provide electrical work as required, complying with requirements of Division 26 sections including, but not limited to raceways, wires, cables, electrical identification, supporting devices and electrical connections for equipment. Work includes, but is not limited to, the following:

1. Interlock and control wiring between field-installed controls, indicating devices and unit control panels.
2. The Contractor shall be responsible for all additional electrical and other costs involved to accommodate the temperature control system panel, motors and electrical devices requiring power which differs from the power requirements shown on the Electrical Drawings.

1.2 QUALITY ASSURANCE

A. Contractor's Qualifications: Firms regularly engaged in installation, commissioning and servicing of digital control equipment, of types and sizes required, whose firm has been in business in similar service for not less than five (5) years. Contractor shall have an established working relationship with the Control System Manufacturer of not less than three (3) years.

B. Only those Contractors who are certified to install DDC systems from specified manufacturers are allowed to bid temperature controls. All bidders shall make available, upon the Owner's request, open book unit pricing of all materials and labor.

C. The system shall be installed by competent mechanics, regularly employed by the Temperature Control Contractor.

D. No Field Devices shall be multiplexed to a single I/O point unless specified. Each device or sensing point shall be terminated at a unique location on the Control Panel, Dedicated Controller or Slave and be associated with a unique software point on the BAS.

E. Codes and Standards:

1. All equipment and the installation shall comply with the requirements of all applicable local and national codes including but not limited to the currently enforced edition of the International Building Code, Fire Code, Electrical Code, and all applicable codes of the National Fire Protection Association including the National Electrical Code.
2. Electrical Standards: Provide electrical products which have been tested, listed and labeled by UL and comply with NEMA Standards.
3. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric control systems.
4. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

F. The Temperature Control Contractor shall cooperate with other contractors performing work on this project necessary to achieve a complete and neat installation. To that end, each contractor shall consult the drawings and specifications for all trades to determine the nature and extent of others work.

G. It will be the responsibility of the Contractor to work in cooperation with the Owner and with all other contractors and employees rendering such assistance and so arrange his work such that the entire project will be delivered complete in the best possible condition and in the shortest time.

1.3 PROPRIETARY INFORMATION

A. Project Documentation: All custom software, passwords, programs, code, databases, graphic files and drawings (whether hard copy or electronic files) prepared for this system shall be the exclusive property of the Owner and shall not be reproduced or distributed without prior written permission from the Owner.

1.4 SUBMITTALS

A. Submit in accordance with Division 1 and 23 submittal requirements.

B. In addition to the requirements set forth in Paragraph A above, the following shall be included in the shop drawing submittals including, but not limited to:

1. Product Data: Submit manufacturer's technical product data sheets for each control device furnished, each data sheet shall be labeled indicating its' control drawing descriptor. When manufacturers data sheets apply to a product series rather than a specific product, the data that is specifically applicable to the project shall be highlighted or clearly indicated by other means. Submittals shall include the following:

    a. Indicating dimensions;
    b. Capacities;
    c. Performance characteristics;
    d. Electrical characteristics;
    e. Finishes of materials;
    f. Installation, start-up, test and verification instructions.

2. Control system drawings containing pertinent data to provide a functional operating system and a sequence of operation.
3. Detailed wiring diagrams.
4. Schematic flow diagram of system showing fans, pumps, coils, dampers, valves, and all control devices. Identify all control points with labeling.
5. Indicate for each control device a set point or adjustable range of control. Provide a bill of materials with manufacturer's part number.
6. Indicate all required point-to-point electrical wiring. Clearly differentiate between portions of wiring that are existing and portions to be field-installed.
7. Provide details of faces of control panels, including controls, instruments, and labeling.
8. Include verbal description of sequence of operation and reference each device described by schematic symbol used.
9. Provide a point list with database input information to include a point name, address, base and span, action and other required information.

10. Provide a detailed test plan and procedure for each HVAC system and for each type of terminal unit control including valves. The test plans shall fully define reporting methods, procedure, equipment utilized, milestones for the tests, identifying the simulation programs, and personnel. The test procedures shall be developed from the test plans and shall consist of instructions for test execution and evaluation. A test report form shall be developed for each point and sequence of operation. Commissioning procedures shall be provided for each HVAC system and for each type of terminal unit control system. The procedure shall include set point, prop. band, integral, derivative, mode constraints input, output settings, tuning procedures., etc.

C. Submit manufacturer's installation instructions.

D. Submittal Data and Shop Drawings shall be prepared and submitted in the following formats:

1. All drawings prepared for the project shall be developed using the AutoCad CADD program Rev. 14.0 or most current version, (or a CADD package capable of producing AutoCad "DXF" compatible format files).
2. All submittals data shall be the same size for any group of information and shall be in a three (3) screw and post binder. (NO EXCEPTIONS). All the information shall be indexed and tabbed with reference to the specific section of these specifications.
3. The format for different groups of submittal information are as follows:

    a. Control drawings, building plans (including complete floor plans), schematics and system configurations shall be CADD prepared drawing, bound and indexed. Drawings that cannot represent the total information on an individual ANSI size B (11" x 17") drawing, i.e., a building plan, shall be noted with appropriate match lines, cross references and key plans.
    b. Technical data, sequence of operations, material list, point lists, program listings, I/O schedules, operator's and programmer's manuals, etc., shall be type written, original product data sheets or CADD prepared drawings, ANSI Size A or ANSI Size B.

4. Upon completion of the project and acceptance of systems, the Contractor shall provide to the Owner two (2) hard copies and one (1) electronic copy (CD or DVD) of Record (As-Built) Shop Drawings.

E. Shop drawings shall include riser diagram depicting locations of all controllers and workstations, with associated network wiring. Also included shall be individual schematics of each mechanical system showing all connected points with reference to their associated controller, written operational sequences and testing and commissioning reports and checklists.

F. Shop Drawings shall be submitted for approval prior to beginning work. When the Architect/Engineer requires, the Contractor will resubmit with the corrected or additional submittal data. This procedure shall be repeated until all corrections are made to the satisfaction of the Engineer and the submittals are fully reviewed.

G. Contractor agrees that shop drawing submittals processed by the Architect/Engineer are not change orders, that the purpose of shop drawing submittals by the Contractor is to demonstrate to the Architect/Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install, and by detailing the fabrication and installation methods he intends to use. The Contractor shall be responsible for space requirements, configuration, performance, changes in bases, supports, structural members and openings in structure, and other apparatus that may be affected by their use.

H. Contractor further agrees that if deviations, discrepancies, or conflicts between shop drawing submittals and the contract documents in the form of design drawings and specifications are discovered either prior to or after shop drawing submittals are processed by the Architect/Engineer, the design drawings and specifications shall control and shall be followed. If alternates do not meet these requirements, it shall be this Contractor's responsibility to remove them and install material originally specified, at no cost to the Owner.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide factory shipping cartons for each piece of equipment, and control device. Maintain cartons through shipping, storage and handling as required to prevent any equipment damage, and to eliminate all dirt and moisture from equipment. Store all equipment and materials inside and protected from weather.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS AND CONTRACTORS

A. Subject to compliance with requirements, install a direct digital control system from one (1) of the following manufacturers / system integrators:

1. Andover by Boulder County

B. All BAS components shall be by one of the above manufacture's, except when "controls provided with the unit," "factory-mounted controls," "unit manufacturer provided controls," etc, are referenced by this specification, "BAS Components" includes BAS Panels/Routers/controllers, and operator interface, color-graphics interface, control and programming software. Valves, actuators, sensors, conventional thermostats and other stand-alone controls and other field devices need not be by the same manufacturer

2.2 GENERAL PRODUCTS DESCRIPTION

A. The Building Automation System (BAS) shall be capable of integrating multiple building functions including equipment supervision and control, alarm management, energy management, historical data collection and archiving, maintenance support, custom processes and manual override monitoring. All products and materials installed shall be suitable for the intended application requirements including but not limited to:

1. Accuracy
2. Rangeability
3. Temperature and pressure ranges
4. Shutoff pressures
5. Differential pressures
6. Repeatability
7. Materials of construction suitable with the environment and/or media in which they are in contact with
8. Code compliance
9. Velocities

B. The BAS shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers, and operator devices. The system architecture shall support a minimum spare capacity of 20% for all types of DDC devices and all point types included in the initial installation. The BAS shall consist of the following:

1. BACnetIP Architecture
2. Operator Work Station
3. Portable Operators Workstation
4. Building Controllers
5. Application Specific Controllers
6. Point Expansion Modules
7. Building Routers
8. Auxiliary Control Devices
9. Valves
10. Dampers
11. Actuators
12. Power Supplies and Line Filtering
13. Wiring and Raceways
14. Sensors/Transmitters

C. BAS architecture shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC controller shall operate independently by performing its' own specified control, alarm management, operator I/O, and historical data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

D. Each DDC controller shall continue to execute its control software, sample input points, and update output points without connection to the DDC panel network, Controller network or an operator interface.

E. All DDC controllers shall be able to access data from, or send control commands and alarm reports directly to, any other DDC controller or combination of controllers on the network without dependence upon a central processing device. All DDC controllers shall also be able to send alarm reports to multiple operator workstations without dependence upon a central processing device.

F. The BAS shall allow third party software to operate on a personal computer operator workstation without any degradation to the controls operating normally.

G. Remote Communications: The BAS shall be remotely accessible via an Internet connection provided by others. Inherent in the system's design shall be the ability to expand or modify the network via the local area network, or auto-dial telephone line modem connections, or via a combination of the two (2) networking schemes.

H. All DDC controllers and application-specific controllers shall be connected to DDC routers via "Controller Network(s)" (BACnet MS/TP). A sufficient number of DDC routers shall be provided to support the number of controllers and application-specific controllers required.

I. A sufficient number of DDC routers/panels/controllers shall be provided to meet the memory needs of the BAS programming, alarming and trending (24 samples for each point alone, not including that needed for Measurement and Verification (M&V) along with 25% spare capacity for future use.

J. A sufficient number of DDC routers/panels/controllers and application-specific controllers (here after referred to in general as "DDC device(s)") and point expansion modules shall be provided to meet the point needs of the project. Point termination types shall include:

1. Analog Input (AI) – Thermistor, 0-10 VDC or 4-20 mADC
2. Binary Input (BI) – Monitoring of dry contacts, including contact closure "pulses" up to 10 per second.
3. Analog Output (AO) – 0-10 VDC, 0-20 VDC or 4-20 mADC
4. Binary Output (BO) – Two state DC voltage signal or magnetically held dry contact closure.

K. An application-specific controller shall not be used for systems/equipment that require custom application programming to meet the Sequence of Operation (i.e., if an application-specific controller is used, the factory-provided control software and program must be able to perform the Sequence of Operation without "upper level" control from a DDC panel, etc.).

L. Digital Communications to Third-party Controls

1. The BAS is required to send/receive information via digital communication technologies (e.g. Ethernet/IP, EIA-485); application protocols (e.g., BACnet, Modbus) to specified Third-Party controls provided under this or other sections of the specification (e.g. chillers, VFDs, BTU meters, electrical submeters, lighting controls, etc.).
2. See the Specification sections of the equipment involved, for the type of communications technology/interface (e.g. the data link layer protocol), and application protocol used by each of the Third-Party controls, and for the list of data to be shared with these controls.
3. Communications not requiring a gateway (i.e., BACnet): Design the BAS to include the DDC device models (with optional modules if necessary) that provide the necessary data link layer interfaces.

M. Hardware Override Monitoring: The BAS shall monitor the status or position of all overrides, and include this information in logs and summaries to inform the operator that

automatic control has been inhibited. The BAS shall also collect override activity information for daily and monthly reports.

N. Power Fail Restart: In the event of the loss of normal power, there shall be an orderly shutdown of all standalone DDC panels to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery back-up shall be provided to support the real-time clock and all volatile memory for a minimum of seventy-two (72) hours.

1. Upon restoration of normal power, the DDC panel shall automatically resume full operation without manual intervention.
2. Should DDC panel memory be lost for any reason, the user shall have the capability of reloading the DDC panel via the local area network and Internet connection.

2.3 BUILDING CONTROLLERS

A. Building Controller is BTL-listed BACnet B-BC device as defined below with non-volatile memory for operating system software; 72-hour battery-backed read/write memory for custom programming; communications support for operator interface and the Controller Network.

B. Building Controller Network- Provide 76.8kps BACnet MS/TP communications (as a master).

C. Point Termination-building controllers shall provide direct point termination through integral point connections, point expansion and/or point expansion modules.

1. Point expansion shall communicate with the Building Control Panel via the Panel's microprocessor bus (i.e., they shall not use EIA-232/485 and/or any type of LAN technology like MS/TP).
2. A "point Expansion Module" as defined below shall be installed within the same enclosure as the associated Building Control Panel.

2.4 APPLICATION CONTROLLERS

A. A DDC panel is a BTL-listed BACnet B-BC or B-AAC device with the BACnet options specified below, non-volatile memory for operating system software: 72-hour battery-backed read/write memory for custom control programming, trending, and alarming; real time clock; integral point or point expansion terminations; and communications support to other DDC routers/panels.

B. DDC Router/panel Network: Provide 100baseT Ethernet minimum communications with BACnet/IP support for interconnection to other DDC routers/panels, operator interfaces, and to an Internet/intranet connection, if specified.

C. Point Termination-DDC panels shall provide direct point termination through integral point connections, point expansion and/or point expansion modules.

1. Point expansion shall communicate with the DDC panel via the Panel's microprocessor bus (i.e., they shall not use EIA-232/485 and/or any type of LAN technology like MS/TP).
2. A "point Expansion Module" as defined below shall be installed within the same enclosure as the associated DDC panel.

2.5 VALVES

A. Control Valves: Provide factory fabricated control valves of appropriate pressure class for the scheduled service. Provide size-modulating valves for a pressure drop of 3 to 5 PSI for water service and 80% of the supply pressure for steam service, unless otherwise noted. Two-position valves shall be line size.

1. Water Service Values: Equal percentage characteristics with range ability of 50 to 1, and maximum full flow pressure drop of 5 psig.
2. Steam Service Valves: Linear characteristics with rangeability of 30 to 1, and maximum full flow pressure drop of 80 percent of inlet pressure for low pressure systems, and 42 percent for high pressure systems
3. Single Seated Valves: Cage type trim, providing seating and guiding surfaces for plug on "top and bottom" guided plugs.
4. Double Seated Valves: Balanced plug type, with cage trim providing seating and guiding surfaces on "top and bottom" guided plugs.
5. Valve Trim and Stems: Polished stainless steel.
6. Packing: Spring-loaded Teflon, self-adjusting.
7. Terminal Unit Control Valves: Provide control valves for control of terminal units including, but not necessarily limited to, convectors, finned tube radiation, and fan-coil units that are of integral motor type. Provide 2–position or modulating type valves.
8. Select valves to fail safe in normally open or closed position as dictated by freeze, humidity, fire or temperature protection.
9. Valves: 1/2" through 2": Valves shall be constructed with a cast-brass body and screwed ends. For 1-1/2" and 2" special duty, valves may be selected by the control manufacturer to have either bronze or cast iron bodies with screwed or flanged connections.
10. Valves: 2 1/2" and above: Valves shall be constructed with a cast-iron body and have flanged connections.
11. Butterfly Valves: high performance valves with stainless steel disc and PTFE steel ring shall be used. Body shall be carbon-steel body, 150 lb full ANSI rated bi-directional, lug style butterfly type, bi-directional dead end pressure rating of 285 psi, and temperature rating of -20 to 300 degrees F. Construction features to include 316 SS electroless nickel plated eccentric rotating disc, dynamic sealed, PTFE seal ring, 17-4 Ph (ASTM A 564 Cind. H1075 or H1100) stainless steel shaft, TFE chevron stem packing SS/DU TFE removal of downstream piping and shall be factory pressure tested to 110% of pressure rating. Valves shall be installed by use of cap screws; threaded rod not acceptable. Tyco Keystone Figure 312 or equal.

2.6 DAMPERS

A. Dampers: AMCA-rated, parallel or opposed-blade design as indicated; 0.108-inch minimum thick, galvanized-steel or 0.125-inch minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.

1. Secure blades to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. Edge Seals, Low-Leakage: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 8 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x Ibf; when tested according to AMCA 5000.

2.7 ACTUATORS

A. Electronic

1. Design for direct mounting on the device and attachment to the driving shaft (damper actuator only); adjustable angle of rotation or range of actuation; and built in overload protection. Size each motor for 150% of the application requirement and with sufficient reserve power to provide smooth action.
2. Modulating actuators shall use a 0-10 VDC or 4-20 mAD signal input to match DDC device AO signal output, and 24 VAC power. Three-wire, bi-directional motor actuators controlled by BO point pairs are acceptable on terminal valve boxes, terminal heating/reheat coils, and fan coil units only.
3. Two-position actuators shall be a 120 VAC, two-wire, spring return. Spring actuation return actuation time shall be less than 30 seconds.
4. Damper Actuators - 95° rotation maximum, with built-in adjustable mechanical stop to limit rotation to that of the damper and/or to meet TAB requirements.
5. End switches- Provide actuator with integral, adjustable-position indication end switches (one for each fully actuated position) when the actuated device is specified with an end switch binary input point(s).

B. Provide valve actuators capable of close-off against a pressure greater than the respective pump system shut-off head.

C. Failsafe: Provide spring-return failsafe upon loss of power or control signal to the positions as follows:

1. OA dampers- N.C.
2. Mixed-air dampers- N.O.
3. Relief- and exhaust-air dampers- N.O.
4. HW coil valves- N.O.

2.8 POWER SUPPLIES AND LINE FILTERING

A. Control transformers shall be UL Listed. Furnish Class 2 current limiting type, or furnish over-current protection in both primary and secondary circuits for Class 2 service per NEC requirements. Limit connected loads to 80% of rated capacity.

1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak to peak. Regulation shall be 1.0% line and load combined, with 100 microsecond response time for 50% load changes. Unit shall have built in over-voltage and over-current protection, and shall be able to withstand a 150% current overload for at least 3 seconds without trip-out or failure.

a. Unit shall operate between 0°C and 50°C [32°F and 120°F]. EM/RF shall meet FCC Class B and VDE 0871 for Class B, and MIL-STD 810C for shock and vibration.
b. Line voltage units shall be UL Recognized and CSA Approved.

B. Power line filtering:

1. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak to peak. Regulation shall be 1.0% line and load combined, with 100 microsecond response time for 50% load changes. Unit shall have built in over-voltage and over-current protection, and shall be able to withstand a 150% current overload for at least 3 seconds without trip-out or failure.

a. Dielectric strength of 1,000 volts minimum.
b. Response time of 10 nanoseconds or less.
c. Transverse mode noise attenuation of 65 dB or greater.
d. Common mode noise attenuation of 150 dB or better at 40 Hz to 100 HZ.

2.9 WIRING AND RACEWAYS

A. General: Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of Division 26.

B. All insulated wire to be copper conductors, UL labeled for 90C minimum service.

C. All exposed wiring shall be installed in conduit.

D. Conduits shall not exceed 40 percent maximum fill for single conductor and jacketed cables.

2.10 SENSORS/TRANSMITTERS

A. All input accuracies required by this section shall be end-to-end (from sensing point to BAS display). End-to-end accuracy includes all errors due to the sensor, transmitter, wiring and BAS signal measurement and A/D conversion.

B. Thermistors or solid state sensors shall be provided for temperature sensing applications except where accuracies or ranges required cannot be met by these devices, RTD's shall be used. The sensors shall be powered by the BAS Panel or Dedicated Controller. The solid state sensors shall be accurate to within +/- 0.5 degree F over the following ranges and meet the following requirements:

1. Room Type Instruments: 50 degree F to 100 degree F. Sensor shall be surface mounted with a ventilated cover, insulated baseplate and vandalproof screws.

a. Each thermostat have the following features and shall match existing:

1) Temperture indication, setpoint adjustment, occupied/unoccupied override button.

2. Duct and Plenum Applications: -30 degree F to 240 degree F. Supply, return, exhaust or mixed air averaging type, which shall have an extended element of sufficient length to cover the entire duct cross-section with a minimum of three (3) passes. If a single averaging thermistor of sufficient length to meet the preceding are not available, then two (2) or more sensors and AIs shall be used and averaged in software.

C. Where RTD's are required, they shall be 1,000 OHM platinum type and be supplied with a 4-20 mA DC transmitter. The sensor and transmitter shall be a single unit. They shall be accurate to within +/- 1.0 degree F over the range of 32 degree F to 600 degree F.

D. Where thermocouples are required, they shall be Type J and be supplied with a 4-20 mA DC transmitter. They shall be accurate to within +/- 2.0 degree F over the range of 32 degree F to 1,300 degree F.

E. Provide matched temperature sensors for applications which require both inlet and outlet temperatures of any device. Where a "Matched Temperature Sensor Pair" is shown/specified, the sensors shall be tested and documented by the sensor manufacturer as being accurate to within 0.1°F of each other.

F. Flow Elements/Transducers:

1. VAV terminal Unit: Provide differential-pressure transducer integral to the application-specific controller. Connect to pitot-tube element provided with terminal unit.
2. Water Flow: Provide Onicon F-1200 series dual turbine insertion flow meter.

G. Wall/Duct Mount CO_2 Transmitter:

1. Description; Measure and transmit CO_2 levels ranging from 0 to 2,000 parts per million ppm. Silicone-based CARBOCAP® sensor delivers high accuracy and long-term measurement stability ($\pm$100 ppm) over a five-year period without calibration. It shall consist of an infrared (IR) source, a sample cell, and IR detector, and a tunable interference filter that enables measurements at two wave lengths. Reference measurements made using a tunable interference filter.

2. Model;

a. Wall Model; CD-Wxx-00-0 Wall Mount CO_2 transmitter.
b. Duct Model; CD-Pxx-00-0 Series Duct Mount CO_2 transmitter.

3. Specifications;

a. Measuring Range: 0 to-2000ppm CO_2.
b. Accuracy at 77°: <± 30m ppm+ 2.0% of reading, includes manufacturing deviation and drift.
c. Non-Linearity: <0.5% of Full Scale.
d. Temperature Dependence of Output: <0.056% of Full Scale/F°.
e. Response Time (0 to 63%): 1 Minute.
f. Operating Temperature Range: 23 to 113°F
g. Humidity Range: 0 to 85% RH (non-condensing)
h. Power Supply Range: 20 to 30 VAC (18 to 30 VDC), Class 2.
i. Power Consumption: <2.5 W Average, 4.1 VA.
j. Air Flow Range: 0 to 7,500 ft/minute
k. Duct Probe Material: Duct probe meets plenum rating requirements of UL 1995, Heating and Cooling Equipment.
l. Agency Listings: UL Listed, CCN XAPX

2.11 TEMPERATURE CONTROL CABINETS

A. General: All controllers and field interface devices shall be installed in control panel cabinet/enclosure as described below.

B. Cabinets shall be UL listed, 14 gauge furniture grade steel, finished with baked enamel painted finish inside and out, cabinet doors shall have piano hinge and standard key cylinder locking latch.

C. All devices installed in or on the control cabinet shall be labeled with a fixed mounted, color contrasted, engraved laminated plastic tags, including describing the function of the device, similar to the following example:

ΔP TRANSMITTER DEVICE

Label

DSP-1, AHU-1 SUPPLY DUCT STATIC PRESSURE TRANSMITTER

D. All electrical devices within the panel shall be prewired to terminal strips with all inter-device wiring within the panel completed prior to installation of the system.

E. Mount control panels adjacent to associated equipment on vibration free walls or free standing steel angle supports or "Unistrut" support stand.

2.12 END SWITCHES

A. All end switches shall be NEMA rated contacts and NEMA 4X enclosure, either SPDT, DPDT DPST as required to meet the Sequence of Operation, complete the Points List and necessary interlocks or safeties control wiring. End switches shall be as manufactured by Cutler-Hammer or Allen-Bradley.

B. All end switches shall be designed and configured to provide positive indication of a control device (i.e. damper or valve) position for the service intended.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The Contractor shall install all equipment, control air piping/tubing, conduit and wiring parallel to building lines.

B. All automatic control valves and control dampers furnished by the Temperature Control Contractor shall be installed under his supervision by the Mechanical Contractor.

C. Install Air Measuring Stations per the manufacturer's requirements.

D. GENERAL INSTALLATION REQUIREMENTS:

1. Spare conductor capacity, equal to a minimum of two (2) additional sensors shall be provided to each underfloor sensor and pendant type sensors.
2. Horizontal runs of conduit, trays, tubing or wiring shall be hung from structural members using new supports, or where feasible, utilizing existing temperature control conduit and piping. The Contractor shall verify adequacy of existing systems and warrant these systems as if they were new. Single runs of conduit, tubing or wire shall be by clevis ring and all thread rod. Multiple runs shall be by "Trapeze" or "Unistrut" supports. "Plumber's Strap" shall not be allowed. Maximum distance between supports shall be per the NEC. Existing supports shall only be used upon written concurrence by the Architect, Engineer or Owner.
3. All vertical runs of conduit or tubing shall be through new core drills. Existing core drills may be used if approved by the Owner. The installation shall be supported above each floor penetration using clamps to "Unistrut".
4. All wire that enters or leaves a building structure shall be installed with lightning protection per NEC.
5. All wire terminations shall be with compression type round hole spade lugs under a pan head screw landing; Stay-Kon or equivalent. All wire splices shall be with compression type insulated splice connectors or properly sized "wire-nut" connectors. Hand twisted, soldered and/or taped terminations or splices are not acceptable.
6. Where tubing, wiring or conduit penetrate floors or walls, sleeves with bushings shall be provided for tubing and wires. The conduit or sleeve opening shall be sealed with fire proof packing so the smoke and fire rating of the wall or floor is maintained.

7. Under no circumstances shall wire, tubing, tray, J-boxes or any BAS equipment be run in, mounted on, or suspended from any of the telephone system's equipment, cable trays or support structure (Grey Iron).
8. All the material installed under this contract must be mounted on, or supported from the building structure or supports furnished by this Contractor.

E. Control Wiring:

1. Run wiring in metallic conduit, tubing or raceways. Exceptions are as follows:

   a. NEC Class 2 low voltage wiring where not exposed to view such as above suspended ceilings, in shafts, etc., may be run in cable (when approved by Code Authority).
   b. Wiring enclosed in temperature control panels.

2. Where conduit is used, provide steel fittings.
3. Low Voltage Conductors: 18 Gauge minimum, except 19 gauge may be used for home runs to central panels and 22 gauge minimum for resistance or thermistor sensing element connections.
4. Wire control interlocks and control panels, except one (1) 120V power circuit to each temperature control panel shown on drawings and schedules shall be provided under Division 1.
5. All wiring shall comply with the requirements of Local and National Electrical Codes.
6. Do not interlock alarms with starter switching to bypass alarm when equipment is manually disconnected.
7. All costs of controls, wiring conduit and associated labor shall be included in the Temperature Control Bid. The control wiring shall be installed under the supervision of this Contractor.

3.2 ENCLOSURES

A. The tubing and wiring within all enclosures shall be run in plastic trays. Tubing and wiring within BAS panels may be run using adhesive-backed tie wraps.

B. All plastic tubing shall be connected to enclosures through conduit. All copper tubing shall be connected to enclosures through bulkhead fittings.

C. Mount all enclosures, including those which house BAS Panels, Slaves and Field Device Panels, so that the top of the enclosure does not exceed six feet, six inches (6'-6"); and the center of any keypad/LCD combination does not exceed five foot, six inches (5'-6") from the floor or is less than four feet, zero inches (4'-0") from the floor.

D. Field Device Panels contain related Field Devices such as relays, control power (24V) transformers, output transducers, etc., that are outboard of the BAS Panels or Dedicated Controllers. Each Field Device shall be mounted within an enclosure. The enclosures shall be provided with lockable latches that will accept a single key common to all Field Device Panels, BAS Panels and Slaves.

3.3 EXISTING CONTROLS

A. Remove all existing control devices including, controllers, receiver/controllers, thermostats, sensors, field devices, gauges, etc. and all associated wiring, piping and mounting hardware whose functions are being replaced by the BAS.

1. When existing equipment is removed, coordinate with a detailed Method of Procedure (MOP). Do not remove until Owner reviews.
2. Refer to General Conditions.

3.4 INSTALLATION PRACTICES

A. The Contractor shall install and calibrate all Field Devices, Sensors and Transducers necessary for the complete operation of the I/O Points described herein.

B. Sensors shall be removable without shutting down the system in which they are installed.

C. All immersion sensors shall be installed in new, welded thermowells supplied by the Contractor. Existing thermowells may be reused with concurrence from the Owner. Coordinate any required shutdown with Owner.

D. Thermistor wire leads shall be permanently terminated at panels or controllers with wire clamps.

E. Where none exist, furnish and install pressure/temperature gauges adjacent to each immersion type sensor.

F. Sensors shall be installed with the use of a wet or hot tap without draining the system if required.

3.5 IDENTIFICATION

A. All control air piping/tubing, J-boxes, conduit and wiring shall be labeled.

B. Electrical devices, wiring, conduit and J-boxes shall be labeled and identified as required by Division 26.

1. As a minimum regardless of Division 26 requirements, all temperature control J-box covers shall be painted Blue in color on both sides of cover.

C. Main supply control air piping and tubing shall be labeled with Brady or equivalent markers or pre-printed identification sleeves at each end and junction point, and protected. Identification scheme shall be consistent with the drawings.

D. Identification shall be provided for all enclosures, panels, junction boxes, controllers or field devices. Laminated, bakelite nameplates shall be used. The nameplates shall be 1/16-inch thick and a minimum of 1-inch by 2-inches. The lettering shall be White on a Blue background with minimum 1/4-inch high engraved letters. The nameplates shall be installed with pop rivets.

1. All new devices will be tagged. Color code to differentiate between new devices.

E. Thoroughly clean the surface to which the label shall be applied with a solvent before applying the identification. Use an epoxy to affix the identification in addition to any adhesive backing on the identification.

F. The Plan Code Designation shown on all shop drawing identification shall be consistent with the Contract Documents.

G. All I/O Field Devices that are not mounted within Field Device Panel enclosures shall be identified with engraved plastic laminated nameplates installed so that they are visible from ground level.

H. The identification shall show the designation used on the Record Documents and identify the function such as "Mixed Air Temperature Sensor" and "Fan Status DP Switch".

I. Calibration settings shall be marked with paint or indelible ink.

3.6 LOCATIONS

A. All sensing devices and locations shall be located by the Contractor as shown on the submittal shop drawings with final review by the Engineer.

B. Wall mount space sensors shall be mounted 48" above finished floor. Pendant mount space sensors shall be mounted 8-feet above finished floor.

C. Enclosures housing Field Devices shall be located immediately adjacent horizontally to the BAS Panels or Slaves which are being interfaced to.

3.7 TEMPERATURE SENSORS

A. Temperature controls trades shall verify all wall mounted temperature sensors locations with the Architect/Engineer/Owner in order to avoid interference with wall mounted and space furnishings.

1. Where interferences require moving the temperature sensor more than two (2) feet, consult with the Architect/Engineer for relocation.

B. Temperature sensors shall be mounted on suitable insulated base and secured to the wall in such a way as to be easily removed from wall without damage to the sensor.

C. Check and verify location of thermostats and other exposed control sensors with plans and room details before installation. Locate thermostats 48" above floor.

3.8 EQUIPMENT PROTECTION AND COORDINATION

A. Where existing walls are penetrated with conduit or piping, provide a fire stop assembly which meets or exceeds the original rating of the assembly. Refer to Division 23.

B. Extreme care must be exercised while working in existing facilities and around operating equipment, particularly sensitive telephone switching and computer equipment. Close coordination with the Owner is required for the protection of this operating equipment from dust, dirt and construction material while maintaining the operational environment for the equipment. Under no circumstances shall the power or environmental requirements of the operating equipment be interrupted during the installation and check-out without submitting to the Architect, Owner and Engineer for approval.

C. A detailed Method of Procedure (MOP) stating the steps to be taken, time schedule and impacted systems for the service interruption shall be submitted to the Architect for approval prior to beginning work. Refer to Division 1 and Division 26 for requirements.

3.9 CLEANUP

A. At the completion of the work, all equipment pertinent to this contract shall be checked and thoroughly cleaned and all other areas shall be cleaned around equipment provided under this contract. Clean the exposed surfaces of tubing, hangers, and other exposed metal of all grease, plaster, dust, or other foreign materials.

B. Upon final completion of work in an area, vacuum and/or damp wipe all finished room surfaces and furnishings. Use extreme care in cleaning around telephone switching and computer equipment and under no circumstances shall water or solvents be used around this equipment.

C. At the completion of the Work and at the end of each work day, remove from the building, the premises, and surrounding streets, etc., all rubbish and debris resulting from the operations and leave all equipment spaces absolutely clean and ready for use.

3.10 SOFTWARE, DATABASE AND GRAPHICS

A. Software Installation: The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

B. Database Configuration: The Contractor will provide all labor to configure those portions of the database that are required by the Points List and Sequence of Operation.

C. Color Graphics: Unless otherwise directed by the Owner, the Contractor will provide color graphic displays for all systems which are specified with a Sequence of Operation, depicted in the Mechanical Drawings for each system and floor plan. For each system or floor plan, the display shall contain the associated points identified in the Point List and allow for set point changes as required by the Owner.

3.11 TEMPERATURE CONTROL DRAWINGS

A. Upon completion of project and after record drawings of the temperature controls have been prepared and reviewed, the Contractor shall provide one (1) complete set of

Temperature Controls Drawings at each Temperature Control Panel. Each set of drawings shall be laminated in a plastic coating. The drawings shall consist of only those control functions associated with the specific control panel and any relevant or pertinent network interface information.

1. The laminated drawings shall have a grommet connection attached to a metal cable or chain which is mechanically fastened to the Temperature Control Cabinet.

3.12 START-UP AND TESTING

A. Prior to Beneficial Use of the BAS, the Contractor shall supply to Architect/Engineer two (2) debugged printouts of all software entered into the BAS. Also supply all user's programming and engineering manuals required to interpret the software. Included in the printouts, though not limited to, shall be the following:

1. Point data base.
2. All custom control programs written in the BAS control language.
3. All parameters required for proper operation of BAS control and utility firmware such as start-stop routines, etc.
4. Printouts or plotted detailed copies of the complete interactive system graphics.

B. The software printout shall be fully documented for ease of interpretation by the Architect/Engineer and Owner, without assistance from the Contractor. English language descriptions shall be either integrated with or attached to the BAS printout. Specifically, the following shall be documented:

1. All point (I/O and virtual) names.
2. All BAS Programming Language commands, functions, syntax, operators, and reserved variables.
3. Use of all BAS firmware.
4. The intended actions, decisions, and calculations of each line or logical group of lines in the custom control program(s). Sequences of operation are not acceptable for use in this documentation requirement.
5. Complete descriptions of and theories explaining all software and firmware algorithms. The algorithms to be described include, but are not limited to, PID, optimum start/stop, demand limiting, etc.

C. Documentation that was supplied as part of the submittals need not be submitted at this time.

D. Upon review of software, a Point-To-Point Test of the BAS installation shall commence. The Contractor shall provide two (2) men equipped with two-way communication and shall test actual field operation of each control and sensing point. This procedure shall occur during off-hour periods. The purpose is to test the calibration, response, and action of every point. Any test equipment required to prove the proper operation of the BAS shall be provided by and operated by the Contractor. Demonstrate compliance that system functions per the Sequence of Operation.

1. Upon review of the Point-To-Point demonstration, the Contractor shall start up the BAS by putting all controlled equipment in automatic and enabling software. Contractor shall commence final software and overall BAS hardware/software debugging.
2. The Point-To-Point demonstration shall include any existing BAS equipment if it affects the operation of the equipment included under this contract.
3. As a minimum, existing conditions shall be maintained during system changeover.

E. Final acceptance of the BAS is contingent upon a hardware/software system test. All groups of points that yield a system of control shall be tested for compliance with the sequences of operation. Included in the test, but not limited to, shall be:

1. BAS Loop Response. The Contractor shall supply a trend data output in graphical form showing the step response of each BAS loop. The test shall show the loop's response to a change in set point which represents a change in the actuator position of at least 25 percent of its full range. The sampling rate of the trend shall be from one (1) to three (3) minutes depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that does not yield temperature control of + 0.2 degree F or humidity control of + 3 percent RH shall require further tuning by the Contractor.
2. Interlocks and other sequences.
3. BAS Control under HVAC equipment failure.
4. HVAC Operation under BAS equipment failure.
5. Battery backup.
6. BAS Control under power failure/restart.
7. Reset schedules.
8. BAS Alarm reporting capability.

F. A detailed test report as defined under Submittals shall be provided indicating its completion and proper system operation.

G. The BAS will not be accepted as meeting the requirements of Beneficial Use until all tests described in this section have been performed to the satisfaction of both the Architect/Engineer and Owner. Any tests that cannot be performed due to circumstances beyond the control of the Contractor shall be exempt from the Beneficial Use requirements if requested in writing by the Contractor and concurred by the Owner and Architect/Engineer. Such tests shall be performed as part of the BAS Warranty.

1. A typed written document stating that the system has been fully checked out on a point by point basis shall be submitted to the Architect/Engineer. All documentation associated with the check out shall be included.

3.13 PROJECT RECORD DOCUMENTS

A. The Contractor shall be responsible for updating all existing Project Record Documents associated with the Scope of Work outlined in the Drawings and Specifications.

B. Prior to final completion of the installation, prepare a complete set of Record Drawings on a clear and legible set of ANSI size 'B' (11" x 17") reproducible prints. The content, format and procedure of the submittal shall be as described by the General Conditions.

C. Provide one (1) laminated and framed set of Control Drawings for each new BAS Control Panel and one (1) for the Facility Control Room, locate as directed by the Engineer.

D. Prior to final completion of the installation, prepare two (2) hard copies and one (1) electronic copy (CD or DVD) of the Operation and Maintenance Manuals. The information is to be or provided in a tabbed and index, three (3) screw and post binder. The information shall include:

1. Operator's Manual with step-by-step procedures for logging On/Off, interrogating the system, producing reports, acknowledging alarms, overriding computer control, and changing firmware parameters.
2. Programmer's manual with complete description of the custom control language and associated editor, including sample written programs. Provide complete sets of all programming forms, applications memorandums, and addenda to the programmer's manual. All software or firmware algorithms shall be completely described and documented.
3. Maintenance, Installation, and Engineering Manual(s) that clearly explains how to debug hardware problems, how to repair or replace hardware, preventive maintenance guidelines and schedules, calibration procedures, and how to engineer and install new points, panels, and operator interfaces.
4. Documentation of all software. List separately all software parameters that will need updating by the Owner such as, though not limited to, holiday, seasonal and start/stop schedules, comfort and duty cycling schedules.
5. All programs, passwords, code, databases, graphic files, CADD drawings and symbol libraries generated for operation of the system shall be included as a part of the system documentation. This information shall be submitted both in hard copy bound format and magnetic media format.
6. Input/Output schedules, data sheets, and all other items required under Submittals. Describe all regular maintenance that will need to be performed on the BAS hardware. List replacement parts with part numbers.
7. Complete original issue documentation and software diskettes for all third party software furnished and installed as a part of the system or required for the operation of the system including text editors, control language program and compiler, database managers, graphics and CADD packages, operating systems and communications software.
8. Complete original issue documentation, installation and operational manuals and supporting software for all third party hardware furnished and installed as a part of the system or required for the operation of the system including remote terminals, user's computer workstation, monitors, graphics and memory boards, printers and modems.
9. During the warranty period, all copies of the drawings and manuals shall be updated to include all hardware and software changes.

E. All of the above documentation shall record the equipment installed under this contract and the exact termination to all other existing control or BAS equipment.

F. The Record Drawings shall document the complete existing control system. This includes all mechanical equipment in work area which has automatic control.

3.14 WARRANTY

A. The Warranty period shall begin on the date of Beneficial Use Completion as authorized by the Architect/Engineer and Owner in writing. Beneficial use shall not occur before the Contractor has performed the tests required. With these requirements met, beneficial use shall not occur until, in the opinion of the Architect/Engineer, the BAS is sufficiently complete to be utilized for the purposes for which it is intended.

1. The warranty start date shall not begin until all phases of the Project are complete, i.e., the Project shall have a single warranty start date.

B. The BAS System shall be guaranteed to be free from defects in material and workmanship and in software design and operation for the period of the warranty after completion of the contract. The Contractor shall provide the necessary skills, labor, and parts to assure the proper operation of, and to provide all required current and preventive maintenance. This warranty shall become effective starting the date of Beneficial Use completion.

1. The hardware warranty shall include all equipment which has been purchased by the Contractor. The existing hardware is not subject to the warranty requirements.
2. All software work completed by the Contractor, associated with existing hardware, is subject to the warranty requirements outlined herein.
3. The Contractor shall respond to all calls during the warranty period for all problems or questions experienced in the operation of the installed equipment and shall take steps to correct any deficiencies that may exist.
4. The response time to any problems shall be four (4) hours maximum (twenty-four) 24-hours per day, seven (7) days per week. Corrective action, temporary or permanent, shall be made within one (1) business day.

C. The Contractor shall maintain on site a backup of all BAS software installed in the system. The backup shall be updated monthly or whenever a change to the software is made. A reload of backup software into the system shall be performed by the Contractor immediately upon notification by the Owner. The reload shall be free of charge unless it is due to a power failure of a duration longer than the battery backup.

D. The Contractor shall optimize all control software to assure acceptable operating and space conditions, and peak energy efficiency.

3.15 TRAINING

A. The Contractor shall provide two 2 hours of training for the Owner's Representative. The training sessions shall be broken into one 1 2-hour session. The training session shall be made available to the Owner prior to the end of the warranty period, but after final completion of the contract. The session shall be given at the Owner's facility. Scheduling shall be approved by the Owner. The training shall focus on general design,

operation, and maintenance procedures of the products installed, though not necessarily the specific system designed, and shall cover:

1. Hardware configuration including PC boards, switches, communication and point wiring, and location and installation of all sensors and control devices.
2. Hardware maintenance, calibration, troubleshooting, diagnostics, and repair instructions.
3. Operation of man-machine interface including logging On/Off, interrogating the system, producing reports, acknowledging alarms, overriding computer control, and changing firmware/software parameters.
4. Programming the BAS using the editor and the design of custom control software.
5. Recovery procedures from both BAS and HVAC failures.

B. The Instructor for the above session shall be an employee of the Contractor, who is qualified to provide customer training and applications support.

END OF SECTION 230900

SECTION 231123 - NATURAL GAS SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This Section includes Distribution Piping Systems for natural gas within the building and extending from the point of delivery to the connections with gas utilization devices. Piping materials and equipment specified in this section include:

1. Pipes, Fittings, and Specialties
2. Special Duty Valves

B. Gas pressures for systems specified in this section are limited to 5 psig.

1.2 DEFINITIONS

A. Pipe sizes used in this specification are Nominal Pipe Size (NPS).

B. Gas Distribution Piping: A pipe within the building, which conveys gas from the point of delivery to the points of usage.

C. Gas Service Piping: The pipe from the gas main or other source of supply including the meter, regulating valve, or service valve to the gas distribution system of the building served.

D. Point of Delivery is the outlet of the service meter assembly, or the outlet of the service regulator (service shutoff valve when no meter is provided).

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of natural gas systems products, of types, materials, sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer Qualifications: Installation and replacement of gas piping, gas utilization equipment or accessories, and repair and servicing of equipment shall be performed only by a qualified installer. The term qualified is defined as experienced in such work (experienced shall mean having a minimum of five (5) previous projects similar in size and scope to this project), familiar with precautions required, and has complied with the requirements of the Authority Having Jurisdiction. Upon request, submit evidence of such qualifications to the Architect.

C. Qualifications for Welding Processes and Operators: Comply with the requirements of ASME Boiler and Pressure Vessel Code, "Welding and Brazing Qualification".

D. Regulatory Requirements: Comply with the requirements of the following codes:

1. NFPA 54 - National Fuel Gas Code, for gas piping materials and components, gas piping installations, and inspection, testing, and purging of gas piping systems.
2. Local Building Code.
3. Utility Compliance: Fabricate and install natural gas systems in accordance with Local Gas Utility Company.
4. IMC Compliance: Fabricate and install natural gas systems in accordance with "International Mechanical Code".

1.4 SUBMITTALS

A. Submit in accordance with Division 1.

B. Welders' qualification certificates, certifying that welders comply with the quality requirements specified under "Quality Assurance" below.

1.5 CLOSEOUT SUBMITTALS

A. Submit in accordance with Division 1.

B. Spare Parts: Furnish to Owner, with receipt, two (2) valve wrenches for each type of gas valve installed.

C. Test Reports specified in PART 3 below.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and legally dispose of liquid from drips in existing gas piping and handle cautiously to avoid spillage or ignition. Notify the gas supplier. Handle flammable liquids used by the installer with proper precautions, and do not leave on the premises from the end of one (1) working day to the beginning of the next.

1.7 SEQUENCING AND SCHEDULING

A. Notification of Interruption of Service: Except in the case of an emergency, notify all affected users when the gas supply is to be turned off.

B. Work Interruptions: When interruptions in work occur while repairs or alterations are being made to an existing piping system, leave the system in safe condition.

C. Coordinate the installation of pipe sleeves for foundation wall penetrations.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Above Grade Exposed Locations:

1. Pipe 2-Inches and Smaller: ASTM A 53, Grade B, Type E, Schedule 40 black steel pipe, electric resistance welded.

a. Fittings:

1) Malleable Iron Threaded Fittings: ANSI B16.3; (Class 125 and 300).
2) Malleable Iron Threaded Unions: ANSI B16.30, Class 150, 250 or 300; selected by Installer for proper piping fabrication and service requirements, including style, end connections, and metal-to-metal seats (iron, bronze or brass).
3) Forged Steel Socket-Welded and Threaded Fittings: ANSI B16.11, except MSS SP-79 for threaded reducer inserts; rated to match schedule of connected pipe (up to 4-inch pipe size).

2. Pipe 2-1/2 Inch and Larger: ASTM A 53, Grade B, Type S, Schedule 40 seamless black steel pipe.

a. Fittings:

1) Steel Flanges/Fittings: ANSI B16.5, including bolting and gasketing of the following material group, end connection and facing, except as otherwise indicated.

a) Material Group: Group 1.1
b) End Connections: Butt-weld
c) Facings: Raised-face

2) Forged Steel Socket-Welded and Threaded Fittings: ANSI B16.11, except MSS SP-79 for threaded reducer inserts; rated to match schedule of connected pipe (up to 4-inch pipe size).
3) Wrought Steel Butt-Welded Fittings: ANSI B16.9, except ANSI B16.28 for short-radius elbows and returns; rated to match connected pipe.

B. Above Grade Concealed Locations:

1. Piping all sizes: ASTM A 53, Grade B, Type S, Schedule 40 seamless black steel pipe.

a. Fittings:

1) Steel Flanges/Fittings: ANSI B16.5, including bolting and gasketing of the following material group, end connection and facing, except as otherwise indicated.

a) Material Group: Group 1.1
b) End Connections: Butt weld
c) Facings: Raised-face

2) Wrought Steel Butt-Welded Fittings: ANSI B16.9, except ANSI B16.28 for short-radius elbows and returns; rated to match connected pipe.

2.2 NATURAL GAS PIPING SPECIALTIES

A. Flexible Connectors: Corrugated Type 304 stainless steel flexible pipe with stainless steel braid and heavy flexible armor shield.

B. Quick Couplers: One-way quick coupler with gas rating in cubic feet per hour equal to equivalent gas appliance rating.

2.3 VALVES

A. Special Duty Valves are specified in this section by their generic name. Refer to PART 3, "VALVE APPLICATION", for specific uses and applications for valve specified.

B. Gas Cocks 2-Inch and Smaller: 150 psi WOG, bronze body, straightaway pattern, square head, threaded ends. Acceptable Manufacturers: Lunkenheimer, Nibco, Powell, Stockham.

C. Gas Cocks 2-1/2 Inch and Larger: MSS SP-78; 175 psi, lubricated plug type, semi-steel body, single gland, wrench operated, flanged ends. Acceptable Manufacturers: Lunkenheimer, Nibco, Powell, Stockham.

PART 3 - EXECUTION

3.1 PREPARATION

A. Precautions: Before turning off the gas to the premises, or section of piping, turn off all equipment valves. Perform a leakage test as specified in "FIELD QUALITY CONTROL" below, to determine that all equipment is turned off in the piping section to be affected.

B. Conform to the requirements in NFPA 54, for the prevention of accidental ignition.

3.2 PIPING INSTALLATION

A. Conform to the requirements of NFPA 54 - National Fuel Gas Code.

B. Locations and Arrangements: Drawings indicate the general location and arrangement of piping systems. Design locations and arrangements of piping take into consideration pipe sizing, flow direction, slope of pipe, expansion, and other design considerations. So far as practical, install piping as indicated.

C. Concealed Locations: Except as specified below, install concealed gas piping in an airtight conduit constructed of Schedule 40, seamless Black steel with welded joints. Vent conduit to the outside and terminate with a screened vent cap.

1. Above-Ceiling Locations: Gas piping may be installed in accessible above-ceiling spaces (subject to the approval of the Authority Having Jurisdiction), whether or not such spaces are used as a plenum. Valves shall not be located in such spaces.
2. Piping In Partitions: Concealed piping shall not be located in solid partitions. Tubing shall not be run inside hollow walls or partitions unless protected against physical damage. This does not apply to tubing passing through walls or partitions.
3. Prohibited Locations: Do not install gas piping in or through a circulating air duct, clothes chute, chimney or gas vent, ventilating duct, dumb waiter or elevator shaft. This does not apply to accessible above-ceiling space specified above. Piping shall not be installed beneath slab on grade floors.

D. Install pipe sleeve and seals at foundation and basement wall penetrations.

E. Seal pipe penetrations of fire barriers using fire barrier penetration sealers.

F. Drips and Sediment Traps: Install a drip leg at points where condensate may collect, at the outlet of the gas meter, and in a location readily accessible to permit cleaning and emptying. Do not install drips where condensate is likely to freeze.

1. Construct drips and sediment traps using a tee fitting with the bottom outlet plugged or capped. Use a minimum of three (3) pipe diameters in length for the drip leg. Use same size pipe for drip leg as the connected pipe.

G. Use fittings for all changes in direction and all branch connections.

H. Install gas piping at a uniform grade upward to risers, and from the risers to the meter, or service regulator when meter is not provided, or the equipment.

I. Connect branch outlet pipes from the top of horizontal lines, not from the bottom or sides.

J. Refer to "Supports and Anchors" specification section.

K. Natural Gas Piping installed on the roof shall be on roller supports.

3.3 TESTING

A. General: Provide temporary equipment for testing including pump and gauges. Test before insulation is installed. Test piping to be concealed prior to permanent enclosure.

B. Provide the Engineer a minimum of twenty-four hours' notice of dates when acceptance test will be conducted. Conduct tests in presence of representative of agency having jurisdiction.

C. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated.

D. System Tests:

1. Compressed Air Test: Pressurize the system to 100 psig or 1.5 times the design pressure, whichever is greater. Maintain pressure until the entire system has been inspected for leaks, but in no case for a time period of less than four (4) hours.
2. Maintain test pressure until the entire system has been inspected for leaks, but in no case less than four hours. Examine all piping, joints, and connections for leakage.

E. Repair failed piping sections by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

F. Prepare written report of testing, indication locations of leaks corrected, method used to correct leaks, number of tests required, and certification that system is leak free. Provide three (3) copies of test results.

3.4 NATURAL GAS PIPING SPECIALTIES

A. Protective Coating:

1. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

   a. Alkyd System: MPI EXT 5.1D.

      1) Prime Coat: Alkyd anticorrosive metal primer.
      2) Intermediate Coat: Exterior alkyd enamel matching topcoat.
      3) Topcoat: Exterior alkyd enamel (flat).
      4) Color: Yellow.

2. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

   a. Latex Over Alkyd Primer System: MPI INT 5.1Q.

      1) Prime Coat: Alkyd anticorrosive metal primer.
      2) Intermediate Coat: Interior latex matching topcoat.
      3) Topcoat: Interior latex (flat).
      4) Color: Yellow.

3. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.5 VALVE APPLICATIONS

A. General: The Drawings indicate valve types, locations, and arrangements.

B. Shutoff Duty: Use gas cocks.

3.6 VALVE INSTALLATIONS

A. Install valves in accessible locations, protected from physical damage. Tag valves with a metal tag attached with a metal chain indicating the piping systems supplied.

B. Install a gas cock upstream of each gas pressure regulator. Where two (2) gas pressure regulators are installed in series in a single gas line, a manual valve is not required at the second regulator.

C. Install pressure relief or pressure limiting devices so they can be readily operated to determine if the valve is free; so they can be tested to determine the pressure at which they will operate; and examined for leakage when in the closed position. Pipe atmospheric vent to outdoors.

D. Solenoid valves shall be mounted with the solenoid in the vertical upright position only.

1. Electrical wiring for solenoid valves is specified in Division 26. Coordinate electrical requirements and connections.

E. Valves shall be installed with unions or other means to facilitate removal or repair without disassembly of connecting piping.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Install gas cock upstream and within 6-feet of gas appliance. Install a union or flanged connection downstream from the gas cock to permit removal of controls.

B. Sediment Traps: Install a tee fitting with the bottom outlet plugged or capped as close to the inlet of the gas appliance as practical. Drip leg shall be a minimum of three (3) pipe diameters in length.

C. Flexible Hose Gas Connectors: U.L. Listed, for use connecting to vibrating equipment; corrugated Type 304 stainless steel flexible pipe with stainless steel braid.

3.8 ELECTRICAL BONDING AND GROUNDING

A. Install above ground portions of gas piping systems, upstream from equipment shutoff valves electrically continuous and bonded to a grounding electrode in accordance with NFPA 70 - "National Electrical Code".

B. Do not use gas piping as a grounding electrode.

C. Conform to NFPA 70 - "National Electrical Code," for electrical connections between wiring and electrically operated control devices.

3.9 FIELD QUALITY CONTROL

A. Piping Tests: Inspect, test, and purge natural gas systems in accordance with NFPA 54, and Local Utility requirements.

B. Test system before covering underground lines.

C. Submit written results of tests to Architect/Engineer.

END OF SECTION 231123

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This section consists of furnishing and installing piping systems associated with heating, chilled, and condenser water systems.

1.2 QUALITY ASSURANCE

A. Comply with ASME B31.9 (Building Service Piping Code) for materials, products, installation, and testing.

B. Pipe and Fitting Manufacturer's Qualifications: Firms regularly engaged in manufacture of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

C. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

D. Before any welding is performed, the Contractor shall submit to the Architect/Engineer, a copy of the Manufacturer's Record of Welder or Welding Operator Qualification Tests and his Welding Procedure Specification together with the Procedure Qualification Record as required by Section IX of ASME Boiler and Pressure Vessel Code.

E. Each manufacturer or contractor shall be responsible for the quality of welding done by his organization and shall repair or replace any work not in accordance with these specifications.

F. Soldering and Brazing Procedures shall conform to ANSI B9.1 Standard Safety Code for Mechanical Refrigeration.

G. To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer. Grooving tools shall be supplied from the same manufacturer as the grooved components.

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

B. Welding Certifications: Submit reports as required for piping work.

C. Brazing Certifications: Submit reports as required for piping work.

1.4 CLOSEOUT SUBMITTALS

A. Submit under provisions of Division 1. Additionally, submit the following information:

1. Valve Schedule for all Valves. For each valve, list valve designation number, valve type, size, location, and function.
2. Written report certifying leak testing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Air Vents (Manual and Automatic):

a. Armstrong Machine Works.
b. Bell & Gossett ITT; Fluid Handling Division
c. Hoffman Specialty ITT; Fluid Handling Division
d. Spirax Sarco

2. Pipe Escutcheons:

a. Chicago Specialty Mfg. Co.
b. Producers Specialty & Mfg. Corp.
c. Sanitary-Dash Mfg. Co.

3. Low Pressure Strainers:

a. Armstrong Machine Works
b. Hoffman Specialty ITT; Fluid Handling Division
c. Metraflex Co.
d. R-P&C Valve; Division White Consolidated Industries, Inc.
e. Spirax Sarco
f. Trane Co.
g. Victaulic Co. of America
h. Watts Regulator Co.

4. Ball Valves

a. Nibco
b. Milwaukee
c. Apollo (Conbraco)
d. Watts
e. Grinnell
f. Victaulic

5. Butterfly Valves

   a. Keystone
   b. Nibco
   c. Milwaukee, "ML" Series
   d. Stockham
   e. Centerline
   f. Watts
   g. Grinnell
   h. Victaulic
   i. Apollo
   j. DeZurik

6. Check Valves

   a. Nibco
   b. Milwaukee
   c. Stockham
   d. Hammond
   e. Grinnell

2.2 PIPING AND FITTINGS

A. General: Working pressure and temperature maximums, 125 psi and 250 degrees F; water service.

B. Copper Pipe: ASTM B88, hard-drawn copper tube, Type K for below ground lines and Type L for above ground lines.

1. Fittings:

   a. Wrought copper solder joint fittings, ASME B16.22
   b. Bronze pipe flanges/fittings, ANSI B16.24 (Class 150 and 300)
   c. Mechanical Pressure-Seal Fittings as manufactured by Viega or Nibco.
   d. Grooved end wrought copper, ASME B16.22 or bronze casting, ASME B16.18 with copper tube dimensioned grooved ends **(flaring of tube ends to IPS dimensions is not permitted)**.

2. Joining Material:

   a. Solder:

      1) ASTM B32, 95-5 tin-antimony, Grade 95TA
      2) ASTM B32 (NSF), Silver-Tin-Copper Alloy

   b. Brazing: AWS A5.8, for underground lines and where copper pipe is connected to brass.

1) Copper phosphorus-Bcup
2) Silver-Bag

c. Grooved Mechanical Couplings:

1) Angle Bolt Pattern Design

3. Unions: ASME B16.22-95. Wrought copper solder joint, ground seat.
4. Dielectric Connections: Fittings having insulating material isolating joined dissimilar metals.

a. Waterway Fittings:

1) ASTM-A53 Xinc electroplated steel pipe casing with inert, non-corrosive thermoplastic lining (NSF/FDA listed).
2) Thread x thread ends 1/2-inch x 3-inch through 4-inch x 6-inch.
3) Groove x thread ends 1/2-inch x 4-inch through 4-inch x 6-inch.
4) Listed by IAPMO/UPC and SBCC PST and ESI.
5) Dielectric unions are not an acceptable substitute for dielectric waterway fittings.

C. Steel Pipe:

1. ASTM A53, Schedule 40, black steel pipe. (Grade B, Type E, electric resistance welded) (Grade B, Type S or A106 high temperature; seamless)
2. Fittings:

a. Threaded: ASME B16.4, Class 125, cast iron, or ASME B16.3, Class 150, malleable-iron. Standard pattern for threaded joints. Threads shall conform to ASME B1.20.1-83.
b. Flanged: ASME B16.1, Class 125, cast iron, raised ground face, bolt holes spot faced.

1) Gaskets: ANSI B16.21, full-faced for cast iron flanges, raised face for steel flanges.

c. Welded: ASTM A234, standard weight, seamless black steel, butt weld.
d. Grooved: ASTM A536 ductile iron, or ASTM A53 steel, grooved ends with grooved mechanical couplings.

3. Unions: ASME B16.39-86, malleable-iron, Class 150, hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.
4. Dielectric Connections: Construct to isolate dissimilar metals, prevent galvanic action, and prevent corrosion.

a. Waterway Fittings:

1) ASTM-A53 Xinc electroplated steel pipe casing with inert, non-corrosive thermoplastic lining (NSF/FDA listed).
2) Thread x thread ends 1/2-inch x 3-inch through 4-inch x 6-inch.

3) Groove x thread ends 1/2-inch x 4-inch through 4-inch x 6-inch.
4) Listed by IAPMO/UPC and SBCC PST and ESI.
5) Dielectric unions are not an acceptable substitute for dielectric waterway fittings.

b. Flanged Connection: Dielectric gasket and bolt kit.

D. Flexible Pipe Connectors: As specified in Section 230548.

E. Copper Pressure-Seal-Joint Fittings:

1. Fittings for 2-inch and Smaller: Wrought-copper fitting with EPDM, O-ring seal in each end.

2.3 VALVES

A. General:

1. Comply with MSS-92 1980 "Valve Users Manual".
2. Sizes: Provide valves of same size as upstream pipe size. Size control valves for required flow.

B. Extended Stems: Where insulation is indicated or specified, provide extended stems to allow full operation of the valve without interference by the insulation.

C. Bypass and Drain Connections: Comply with MSS SP-45.

D. End Connections: As specified in the individual valves specifications.

1. Threads: Comply with ANSI B2.1.
2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze.
3. Solder-Joint: Comply with ANSI B16.18. Where soldered end connections are used, use solder having a melting point below 840 degree F for gate, globe, and check valves and below 421 degree F for ball valves.

E. Ball Valves:

1. 3-Inch and Smaller: MSS-SP-110, 150 psi SWP, 600 psi WOG, two-piece ASTM B584 cast bronze body, full port, chrome plated brass/bronze ball, TFE seats, anti-blowout stem separate packnut with adjustable stem packing, extended stem, and vinyl covered steel handle. Threaded or soldered end connections. Nibco T/S 585-70.

F. Butterfly Valves:

1. 4-Inch and Larger: MSS-SP-68, ASTM A126, Class B fully lugged iron body, ASTM B148 aluminum bronze disc, ASTM A582 416 stainless steel stem, RTFE seat liner, reinforced nylon bearings, (EPDM) (BUNA) bushing and NBR stem seals. ASTM class 200 WOG rating. (BUNA) (EPDM) liner, Rated for 200 psi

bi-directional shutoff and 200 psi dead-end service with downstream piping removed. Provide extended neck for insulation. Sizes 4"–6" shall be lever operated with 10-position throttling plate; sizes 8-inch and larger shall have weatherproof gear operators.

G. Check Valves:

1. Swing Check Valve:

a. 2-1/2 Inch and Smaller: MSS SP-80; Class 150 SWP, ASTM B62 bronze body and bonnet, horizontal swing design, Y-pattern, with TFE seat disc. Threaded or soldered end connections. Nibco T/S 433-Y
b. 3-Inch and Larger: MSS SP-71; Class 125, ASTM A126 Class B cast iron body with bronze trim, non-asbestos gasket, horizontal swing, and flanged ends. Valve shall be capable of being refitted without removing from pipe. Nibco F918-B.

H. Drain Valve: Ball valve with threaded hose end and cap with chain. Apollo Fig. 78-100/78-200 Series

2.4 PIPING ACCESSORIES

A. Automatic Air Vent: Float type vent designed to vent automatically; bronze body and nonferrous internal parts. 150 psig working pressure, 240 degree F operating temperature. 1/4-Inch discharge connection and 1/2-inch inlet connection.

B. Drain Pans: Minimum 18 gauge stainless steel, reinforced to support weight of drain pan and water. Provide not less than 2-inch deep, with a 3/4-inch drain connection.

2.5 STRAINERS

A. Low Pressure Pipeline Strainers

1. General: Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 psi working pressure, with Type 304 stainless steel screens, with 3/64-inch perforations at 233 per square inch.
2. Threaded Ends, 2-Inch and Smaller: Cast iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
3. Threaded Ends, 2-1/2 Inch and Larger: Cast iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
4. Flanged Ends, 2-1/2 Inch and Larger: Cast iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
5. Butt Welded Ends, 2-1/2 Inch and Larger: Schedule 40 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.
6. Grooved Ends, 2-1/2 Inch and Larger: Tee pattern, ductile-iron or malleable-iron body and access end cap, access coupling with EDPM gasket.

PART 3 - EXECUTION

3.1 PIPE APPLICATIONS

A. 2-Inches and Smaller:

1. Black Steel: Install steel pipe with threaded joints and fittings.
2. Copper Pipe:

   a. Install Type L copper pipe with wrought copper fittings and solder joints, above ground, within building.
   b. Install Type K copper pipe with wrought copper fittings and brazed alloy joints below ground.
   c. Contractor Option: Pressure-Seal Fittings with Type L pipe above ground within the Building.

B. 2-1/2 Inches and Larger: Install black steel pipe.

1. Welded and Flanged Joints: Install welded fittings on pipe 2-1/2 inches and larger.

3.2 PIPING INSTALLATION, GENERAL

A. Arrange piping in horizontal groups, each group to be in one plane. Maintain indicated slope.

B. Conceal pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors.

C. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Install piping parallel to permanent elements of building. Provide space to permit insulation applications, with 1-inch clearance outside insulation. Provide 2-inch space above removable ceiling panels to allow for panel removal.

D. Fire and Smoke Wall Penetrations: Maintain the fire and smoke rated integrity where pipes pass through fire and smoke rated walls, partitions, ceilings, and floors. Refer to Section 230500.

E. Sloping, Air Venting, and Draining:

1. Install piping true to line and grade, and free of traps and air pockets. Install piping level except for gravity flow systems such as condenser water and condensate drain piping.
2. Connect branch piping to bottom of mains, except for up-feed risers, which shall have take-off on top of main.
3. Install manual air vents at high points in hydronic piping systems and at all coils. Provide 1/4-inch copper, 180 degree bend pipe to discharge vented water into can.

4. Install automatic air vent on air separator and where shown. Provide valved inlet and route discharge pipe to floor drain.
5. Install drain valves with hose adapters at low points in mains, risers, and branch lines. Drain consists of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.

F. Fittings: Standard manufactured fittings. Field fabricated fittings and bushings are prohibited on all piping.

G. Make reductions in pipe sizes using eccentric reducer fitting installed with the level side up.

H. Unions: Install unions in pipes 2-inch and smaller, adjacent to each valve, at final connections of each piece of equipment and elsewhere to permit alterations and repairs. Install dielectric waterway fittings to join dissimilar metals.

I. Flanges: Install flanges on valves and equipment having 2-1/2 inch and larger connections.

J. Joints:

1. Threaded Joints: Apply Teflon tape to male equipment threads. Do not use pipe with threads that are corroded or damaged.
2. Soldered Joints: Comply with AWS Soldering Manual-98.
3. Grooved Joints: Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations. The gasket style and elastomeric material (grad) shall be verified as suitable for the intended service as specified. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing.

K. Keep openings in piping closed during construction to prevent entrance of foreign matter.

L. Install flexible connectors or grooved flexible couplings at inlet and discharge connections to base-mounted pumps and other vibration producing equipment.

M. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical spaces.

N. Pressure-Seal Fittings shall have EPDM seal material compatible with glycol, chemical treatment, corrosion inhibiters, etc.

O. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

3.3 VALVES

A. Field check valves for packing and lubricant. Replace leaking packing. Service valves with lubricant for smooth and proper operation before placing in service.

B. Install valves accessible from floor level, located for easy access.

C. Install valves in horizontal piping with stem at or above center of pipe. Install valves in position to allow full stem movement. Provide operating handles for valves and cocks without integral operators.

D. Provide extended valve stems where insulation is specified.

E. Provide separate support where necessary.

F. Where soldered end connections are used for valves, use solder having a melting point below 840 degrees F for gate, globe, and check valves; below 421 degrees F for ball valves.

G. Provide valves same size as line size.

H. Provide drain valves and hose adapters at strainers for blowoff; same size as strainer blowoff connection.

I. Provide mechanical actuators with chain operators where valves 2-1/2 inches and larger are mounted more than 6-feet above the floor. Extend chains to elevation of 5-feet above floor.

J. Check Valves:

1. Install check valves for proper direction of flow as follows:

   a. Swing Check Valve: Horizontal position with hinge pin level.
   b. Wafer Check Valve: Horizontal or vertical position, between flanges.

K. Valve End Selection: Select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size 2-Inch and Smaller: Solder ends.
2. Steel Pipe Sizes 2-Inch and Smaller: Threaded or grooved-end.
3. Steel Pipe Sizes 2-1/2 Inch and Larger: Flanged or grooved end.
4. At all piping hot taps provide a gate valve with the hot tap and a butterfly valve for shutoff service. Hot taps shall be provided only where approved by the Engineer.

L. Valve Application: Install valves in accordance with the following table.

SERVICE	**VALVE TYPE**
Hydronic Isolation; 2" and Smaller	Ball Valve
Hydronic Isolation; 2-1/2" and Larger	Butterfly Valve
Hydronic Throttling or Bypass Valve; All Sizes	Globe Valve
Hydronic Balancing Valve; 2" and Smaller	Calibrated Balancing Valve

SERVICE	VALVE TYPE
Hydronic Balancing Valve; 2-1/2" and Larger	Calibrated Balancing Valve

3.4 DRAIN PANS

A. Install drain pan under the entire length of any piping, including valves, joints, and fittings installed over motor, motor starter, switch gear, transformer, or other electrical equipment and under all piping located anywhere in any transformer vault, electrical switchboard room, and telephone equipment room. Pipe drain connection to discharge where shown or at nearest floor drain.

3.5 TESTING

A. General: Provide temporary equipment for testing including pump and gauges. Test before insulation is installed. Test piping to be concealed prior to permanent enclosure.

B. Provide the Engineer a minimum of twenty-four hours notice of dates when acceptance test will be conducted. Conduct tests in presence of representative of agency having jurisdiction.

C. Test piping systems using ambient temperature water, except where there is risk of damage due to freezing. Engineer approval is required prior to testing if other than hydrostatic tests are used.

D. Use vents installed at high points in the direction of flow, in the system to release trapped air while filling the system. Use drains installed at low points for complete removal of the liquid.

E. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated.

F. System Tests:

1. Hydrostatic Test: Pressurize the system to 100 psig or 1.5 times the design pressure, whichever is greater. Maintain pressure until the entire system has been inspected for leaks, but in no case for a time period of less than four (4) hours.
2. Compressed Air or Nitrogen Test: Compressed air tests may be substituted for hydrostatic tests only when ambient conditions or existing building conditions prohibit safe use of hydrostatic testing and must be reviewed by the Engineer prior to any testing. For tests of this type, subject the piping system to the gas pressure indicated for that specific system. Maintain the test pressure for the duration of a soapy water test of each joint.
3. Maintain test pressure until the entire system has been inspected for leaks, but in no case less than four hours. Examine all piping, joints, and connections for leakage.

G. Repair failed piping sections by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

H. Drain test water after testing and repair work has been completed.

I. Prepare written report of testing, indicating locations of leaks corrected, method used to correct leaks, number of tests required, and certification that system is leak free. Provide three (3) copies of test results.

3.6 ADJUSTING AND CLEANING

A. Flush system with clean water. Remove, clean, and replace strainer screens.

B. After cleaning and flushing but before balancing, remove disposable fine mesh strainers in pump suction diffusers.

3.7 HYDRONIC SPECIALTIES INSTALLATION

A. Manual Air Vent: Provide manual air vents at all high points and drops in the direction of flow, of all mains and risers of the hydronic systems, at heat transfer coils, radiation and elsewhere shown and as required for system air venting.

1. Provide enlarged air collection standpipe where large air quantities can accumulate.
1. Provide a 1/2-inch ball valve, reducer and pipe nipple installed between hydronic system pipe and manual air vent.
2. Provide 1/4-inch discharge pipe from manual air vent discharge connection to nearest floor drain or as indicated.

B. Strainers: Install strainers full size of pipeline, in accordance with manufacturer's installation instructions. Install pipe nipple and shutoff full port ball valve with 3/4-inch hose end and brass cap with hose "washer" and chain in strainer blowdown connection. Where indicated, provide drain line from shutoff valve to plumbing drain, full size of blowdown connection.

1. Provide strainers in supply line ahead of the following equipment, and elsewhere as indicated.

a. Control Valves
b. Solenoid Valves

3.8 MECHANICAL COUPLING TOOLS

A. Provide a complete set of mechanical coupling tools to the owner at the completion of the project.

3.9 TRAINING

A. Provide two (2) hours of instruction on hydronic systems. Include following items as a minimum:

1. Location of automatic and manual air vents.
2. Location of strainers and blow down valves.
3. Location of safety and relief valves.
4. System drain valves.
5. System fill and associated devices.
6. Expansion tank and air separator.

B. A factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed product.

END OF SECTION 232113

SECTION 233113 - METAL DUCTWORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of Metal Ductwork is indicated on the drawings, schedules, and by requirements of this section.

Ductwork Construction Table

Service	Type	Pressure Class	Insulation	Seal Class
Supply Air between Air Handling Unit and Terminal Air Box Interior	Galvanized steel, round or rectangular	+3"	Wrapped (Interior), Insulated and Jacketed (Exterior)	B
Supply Air between Terminal Air Box and Air Devices (concealed)	Galvanized steel, round or rectangular	+1"	Lined	C
Supply Air between Terminal Air Box and Air Devices (exposed)	Spiral seam round galvanized steel suitable for painted finish	+1"	Lined	C
Return Air	Galvanized steel, round or rectangular	-3"	Lined	B
Air Handling Unit Exhaust and Outside Air	Rectangular galvanized steel	+3"	Wrapped	B
Exterior Supply and Return	Galvanized steel round or rectangular	3"	Lined	B
General Building Exhaust	Galvanized steel round or rectangular	-3"	None	B
Transfer Duct	Rectangular galvanized steel	+1"	Lined	C

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer's Qualifications: Firm with at least three (3) years of successful installation experience on projects with metal ductwork systems similar to that required for project.

C. References to SMACNA, ASHRAE and NFPA are minimum requirements, the Contractor shall fabricate, construct, install, seal and leak test all ductwork as described in this specification and as shown on the drawings, in addition to these minimum standard references.

D. Codes and Standards:

1. SMACNA "HVAC Duct Construction Standards, Metal and Flexible".
2. SMACNA "HVAC Air Duct Leakage Test Manual".
3. ASHRAE "Systems and Equipment Handbook", Chapter 16, Duct Construction.
4. NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions.

B. Shop Drawings: Submit scale drawings of ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials, and rigidity are not reduced. Refer also to specification for 3D coordination drawing requirement.

C. Record Drawings: At project closeout, submit record drawings of installed systems, in accordance with requirements of Divisions 1 and 23.

D. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include maintenance data and shop drawings in maintenance manual.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protection: Protect ductwork and accessories from damage during shipping, storage, and handling. Prevent dirt and moisture from entering ducts and fittings.

B. Storage: Where possible, store ductwork inside. Where necessary to store outside, enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Rectangular Duct Liner:

a. CertainTeed Corp.

b. Johns-Manville Products Corp.
c. Knauf Fiberglass
d. Manson
e. Owens-Corning Fiberglas Corp.

2. Round Duct Liner:

a. Johns-Manville Products Corp.

3. Flexible Ducts and Sound Attenuating Flexible Ducts:

a. Flexmaster
b. Thermaflex
c. Ominair
d. JP Lamborn Co.

4. Spin-In Fittings:

a. Flexmaster
b. Thermaflex
c. Ominair
d. Hercules Industries

5. Duct Sealants

a. Duct Mate Pro Seal
b. Foster 32-19/32-17
c. Childers CP-146/CP-148

6. Adhesives: Comply with ASTM C916 Type II

a. Foster 85-60
b. DuroDyne SSG
c. McGill Air Seal Uni Grab
d. Childers CP-127

2.2 DUCTWORK MATERIALS

A. Exposed Ductwork: Where ductwork is exposed to view in occupied spaces, provide mill phosphatized finish that is free from visual imperfections, including pitting, seam marks, roller marks, stains, dents, discolorations, and other imperfections, including those that would impair painting.

B. Galvanized Steel Sheet: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lockforming quality; with G 90 zinc coating in accordance with ASTM A 525.

2.3 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Provide materials of types and sizes required to comply with ductwork system requirements.

B. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15-degree change of direction per section. Unless specifically detailed otherwise, use 45-degree laterals and 45-degree elbows for branch takeoff connections. Where 90-degree branches are indicated, provide conical type tees.

C. Rectangular Duct Liner: ASTM C1071 fiberglass duct liner with UL approved 25/50 flame/ smoke development. Factory applied edge and air surface coating of acrylic treated with EPA registered ASTM G21 and G22 anti-microbial agent.

1. K Value: ASTM C 518, 0.25 at 75 degree F mean temperature.
2. Noise Reduction Coefficient: ASTM C 423, 0.70 based on Type A Mounting.
3. Maximum Velocity: 5000 fpm.
4. Adhesive: Meeting ASTM C919.
5. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.
6. Interior Ductwork: 1-Inch thick.
7. Exterior Ductwork: 2-Inch thick.

D. Round Duct Liner: 1-Inch thick rigid preformed round liner with air surface coated with acrylic coating treated with EPA registered ASTM G 21 and G22anti-microbial agent and UL approved 25/50 flame/smoke development.

1. K Value: ASTM C 518, 0.23 at 75 degree F mean temperature.
2. Noise Reduction Coefficient: ASTM C 423, 0.70 based on Type A mounting.
3. Maximum Velocity: 5,000 fpm.

E. Duct Sealant: UL 181 Listed, Class 1, flame spread 0, fuel contributed 0, smoke developed 0, water-based sealant, non-toxic, non-combustible, and non-flammable. Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork. Sealant shall meet LEED IEQ 4.1 (meeting VOC tables published by SCAQMD #1168 Criteria for Low Emitting Materials.

1. Service temperature -20°F to 200°F.
2. Mold and Mildew resistant
3. VOC: Maximum 50g/l (less water and exempt solvents).

F. Adhesives: Water based; suitable for bonding fibrous duct wrap and duct liner insulation to galvanized duct work. Install evenly and secure with mechanical fasteners in accordance with SMACNA HVAC Duct Construction Standard for Metal and Flexible Duct. Adhesive shall meet LEED EQ 4.1 (SCAQMD Rule #1168 VOC tables) low emitting materials. **LEED for Schools** 2009 IEQ Credit 4.1 – Fiberglass adhesives shall meet California Dept. of Public Health (CDPH) Standard Method Ver. 1.1, 2010 Small Scale Chamber Test for VOC's for CA Specification 01350.

1. Non-Oxidizing
2. Meets FDA, USDA and EPA Standards

3. Meets Requirements of UL 723, ASTM E-84 NFPA 90A & 90B and ASTM C-916 Type II.

G. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

1. For exposed stainless steel ductwork, provide matching stainless steel support materials.
2. For aluminum ductwork, provide aluminum support materials except where materials are electrolytically separated from ductwork.

H. Flexible Ducts: Flexible air ducts shall be listed under UL-181 standards as Class I Air Duct Material and shall comply with NFPA Standards 90A and 90B. Minimum operating pressure rating shall be 6-inch w.c. through a temperature range of -20 degree to 150 degree F; maximum working velocity rating shall be 4,000 fpm. Contractor shall assume responsibility for supplying material approved by the Authority Having Jurisdiction.

1. All insulated flexible ducts shall be constructed on an all metal, CPE, or aluminum laminate inner core, fiberglass insulation with minimum R-Valve of 4.0 or greater and an outer jacket made exclusively of fire retardant reinforced material.
2. Non-insulated flexible ducts shall be constructed from dead soft aluminum sheet, spiral corrugated, or aluminum construction over a steel spring helix.

I. Spin-in Fittings: Provide spin-in fittings between flexible and round sheet metal duct takeoffs and air devices from main ducts. Spin-in fittings shall include bell mouth and butterfly type manual volume damper with bearings, regulator and locking device.

J. Rectangular-to-Round Taps: Where the round branch take-off will not permit a spin-in fitting, provide a rectangular to round tap. Include manual volume damper with locking devices.

K. All fasteners and hardware for stainless steel ductwork shall be made of stainless steel.

2.4 FABRICATION

A. Fabricate ductwork of gauges and reinforcement complying with SMACNA "HVAC Duct Construction Standards" and ASHRAE "Systems and Equipment Handbook", Chapter 16, Duct Construction.

B. Elbows – Rectangular

1. For low pressure systems use 1.0 radius smooth elbows. (From focal point to centerline of duct).
2. For medium pressure systems use 1.5 radius smooth elbows. (From focal point to centerline of duct).
3. If radius elbows cannot fit, use mitered elbows with turning vanes.

C. Limit angular tapers to 30 degree for contracting tapers and 20 degree for expanding tapers.

D. Refer to Division 23, Section 233300 "Ductwork Accessories" for accessory requirements. All fume hood exhaust ductwork accessories shall be PVC coated. All stainless steel ductwork shall have stainless steel accessories construction.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF METAL DUCTWORK

A. General: Assemble and install ductwork in accordance with recognized industry practices that will achieve airtight and noiseless (no objectionable noise) systems. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8-inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type that will hold ducts true-to-shape and prevent buckling, popping or compressing. Support vertical ducts at every floor.

B. Inserts: Install concrete inserts for support of ductwork in coordination with formwork, as required to avoid delays in work.

C. Routing: Locate ductwork runs vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by drawings, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2-inch where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1-inch clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

D. Electrical Equipment Spaces: Do not route ductwork through transformer vaults and electrical equipment spaces and enclosures.

E. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on all four (4) sides by at least 1-1/2 inch. Fasten to duct only.

F. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

G. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.

H. Temporary Closure: At ends of ducts that are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering that will prevent entrance of dust and debris until time connections are to be completed.

3.3 INSTALLATION OF DUCT LINER

A. Install duct liner in accordance with SMACNA HVAC Duct Construction Standards.

B. Adhere insulation to sheet metal with full coverage of adhesive.

C. Mechanical fasteners should be of length sufficient to limit compression of liner.

D. All exposed edges of the liner must be factory or field coated.

E. Repair liner surface penetrations with adhesive.

3.4 INSTALLATION OF FLEXIBLE DUCTS

A. Do not exceed 6'-0" for any flexible duct run.

B. Do not extend past 90° when connecting to Grilles, Registers or Diffusers.

C. Install in accordance with Chapter 3 of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".

3.5 LEAKAGE TESTS

A. Ductwork systems in 4-inch W.G. pressure class and higher shall be tested in their entirety for leaks.

B. Conduct duct leakage test in accordance with SMACNA "HVAC Air Duct Leakage Test Manual". Repair leaks and repeat tests until total leakage is less than the maximum permissible leakage as specified below.

C. Architect/Engineer shall observe ductwork pressure tests prior to installation of insulation.

D. Testing pressure shall be 125 percent of designed duct operating pressure.

E. Maximum Permissible Leakage: Two percent of total system.

3.6 ADJUSTING AND CLEANING

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances. Where ductwork is to be painted, clean and prepare surface for painting.

B. Balancing: Seal any leaks in ductwork that become apparent in balancing process.

END OF SECTION 233113

SECTION 233300 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Types of Ductwork Accessories required for project include the following:

1. Manual Volume Dampers
2. Control Dampers
3. Counterbalanced Relief Dampers
4. Smoke Dampers
5. Static Fire Dampers
6. Dynamic Fire Dampers (Curtain Style Blades)
7. Dynamic Fire Dampers (3-V Blades)
8. Combination Fire/Smoke Dampers
9. Turning Vanes
10. Duct Hardware
11. Duct Access Doors
12. Flexible Connections

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.

C. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers" and UL Standard 555S "Motor-Driven Fire/Smoke Dampers".

D. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

E. SMACNA Compliance: Comply with "Fire Damper and Heat Stop Guide" for the installation of fire, smoke, and fire/smoke dampers.

F. All fire dampers, smoke dampers, fire/smoke dampers and radiation dampers shall meet the latest local building code requirements.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction, and installation instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components. Include details of construction equipment and accessories being provided.

C. Submittals for all damper types specified in this section shall include a schedule for each damper indicating net free area, actual face velocity and pressure drop (at sea level) based on net free area and the maximum air quantity which will be passing through the damper. Submittals without this information will be rejected.

D. Record Drawings: At project closeout, submit record drawings of installed systems products, in accordance with requirements of Division 1.

E. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Dampers:

a. American Warming and Ventilating
b. Air Balance, Inc.
c. Arrow Louver & Damper; Division of Arrow United Industries, Inc.
d. Louvers & Dampers, Inc.
e. Penn Ventilator Co.
f. Dowco Corp.
g. Air Stream
h. Cesco-Advanced Air
i. Ruskin
j. Vent Products Inc.
k. Greenheck
l. Pottorff
m. NCA, Industries, Inc.

2. Smoke, Static/Dynamic Fire, and Combination Fire/Smoke Dampers:

a. Air Balance, Inc.

b. Ruskin
c. Greenheck
d. Pottorff
e. NCA Industries, Inc.

3. Turning Vanes:

a. Aero Dyne Co.
b. Airsan Corp.
c. Barb-Aire
d. Duro Dyne Corp.
e. Environmental Elements Corp.; Subs. Koppers Co., Inc.
f. Hart & Cooley Mfg. Co.
g. Hercules

4. Duct Hardware:

a. Ventfabrics, Inc.
b. Young Regulator Co.

5. Duct Access Doors:

a. Flexmaster (Inspector Series)
b. Cesco-Advanced Air
c. Duro Dyne Corp.
d. Ventfabrics, Inc.

6. Flexible Connections:

a. Duro Dyne Corp.
b. Ventfabrics, Inc.
c. General Rubber Corp. (Process and Exhaust Only)

2.2 DAMPERS

A. Low Pressure Rectangular Dampers (Less than 2,000 FPM and Under 4-Inch W.C. S.P. Differential):

1. For 12-inch in height or larger, use multiple opposed blade type and close fitted to ducts. 16 Gauge galvanized steel frame and blades with carbon steel shaft mounted with stainless steel bearings, stainless steel jamb seals and silicone blade edge seals. Linkage shall be in-jamb fixed type located outside the airstream made of plated steel tie bar and crank plates, with stainless steel pivots. Maximum damper panel width is 48-inch. Provide jack shafting when duct size required is greater than 48-inch wide. Provide notched shaft end indicating damper position, locking quadrant to fix damper position and handle. For flat oval and round ductwork, provide Type C housing.
2. For ducts less than 12-inch in height, use 16 gauge frame and 20 gauge blade galvanized steel, steel axle with nylon bearings, locking quadrant handle and notched shaft end indicating damper position.

B. Low Pressure Round Dampers (Less than 1,500 FPM and Under 1-Inch W.C. S.P. Differential):

1. For Dampers 4-inch diameter through 18-inch diameter use 18 gauge galvanized steel frame and the following blade construction:

4-Inch thru 12-inch diameter	22 gauge galvanized steel
13-Inch thru 18-inch diameter	20 gauge galvanized steel

2. Carbon steel axle shaft with retainers mounted on stainless steel bearings with notched end shaft indicating damper position, locking quadrant and handle.

C. Medium High Pressure Rectangular Dampers (Less than 4,000 FPM and Under 6-Inch W.C. (48-Inch Wide or Less) S.P. or 8-Inch W.C. S.P. (36-Inch Wide or Less)):

1. Use opposed blade dampers for volume control and parallel blade for isolation/shutoff service.
2. 16 Gauge galvanized steel frame with welded corners. Double skin galvanized steel blades with single-lock seam, airfoil shape. Double durometer vinyl blade edge seals and metallic compression seals at the jambs. Solid carbon steel axles mounted on stainless steel bearings. In-jamb type linkage located outside the air stream. 48-Inch wide and 60-inch high maximum damper size. For fixed position balancing damper, delete blades to maintain 30 percent free area with all other damper blades are 100 percent closed. For isolation or shutoff duty, damper leakage shall not exceed 9.5 CFM/square foot at 4-inch W.C. S.P. differential. Provide extended shaft with notched end indicating damper position, locking quadrant and handle.

Air Balance Model AC-515/AC-516 (Steel)

D. Medium/High Pressure Round and Flat Oval Dampers (Less than 3,000 FPM and Under 4-Inch W.C. S.P. Differential):

1. Galvanized steel damper frame construction as follows:

ROUND

Under 6-inch diameter	12 gauge
6-Inch to 18-inch diameter	14 gauge
20-Inch to 30-inch diameter	2 x 1/2 x 1/8 channel
32-Inch to 42-inch diameter	2 x 1 x 1/8 channel

FLAT OVAL

6-Inch to 18-inch wide	2 x 1/2 x 14 gauge channel
19-Inch to 48-inch wide	2 x 1/2 x 1/8 channel
49-Inch to 72-inch wide	(6-inch to 18-inch high) 2 x 1/2 x 1/8 channel (19-inch to 26-inch high) 2 x 1/2 x 1/8 channel

2. Galvanized steel damper blades as follows:

ROUND

4-Inch to 12-inch diameter	14 gauge
14-Inch to 18-inch diameter	12 gauge
20-Inch to 42-inch diameter	10 gauge

FLAT OVAL

6-Inch to 12-inch wide	14 gauge
13-Inch to 18-inch wide	12 gauge
20-Inch to 42-inch wide	10 gauge

3. 1/2-Inch diameter galvanized steel axles up to 18-inch diameter and 18-inch wide flat oval, and 3/4-inch diameter plated steel sleeve pressed in to the frame with stainless steel thrust washers with stainless steel bearings.
4. Provide notched end shaft to indicate damper position, locking quadrant and lever handle.

2.3 COUNTERBALANCED PRESSURE RELIEF DAMPERS

A. Standard counterbalanced back draft dampers (designed for maximum 1500 fpm spot velocities and up to 4-inches w.g. back pressure, depending on damper size):

1. .090-Inch minimum wall thickness extruded aluminum frame with 12 gauge galvanized steel structural brace at each corner.
2. .070-Inch roll-formed aluminum blades with extruded vinyl blade edge seals mechanically locked into blade edge. Adhesive or clip-on seals are unacceptable.
3. Field adjustable, zinc plated steel counter balance weights to allow pressure relief at less than 0.01-inches w.g.
4. Synthetic bearings, 1/2-inch wide tie bear linkage concealed in the frame.
5. Ruskin CBD4.

2.4 DYNAMIC FIRE DAMPERS (CURTAIN STYLE BLADES)

A. General: Dynamic fire dampers with curtain style blades meeting the requirements of UL Standard 555 6th Edition.

B. Rating: UL 555 fire resistance rating of 1-1/2 hours.

C. Fire Closure Temperature: Heat responsive device (fusible link) rated to close the damper when temperature at the damper reaches 165 degree F.

D. Differential Pressure: Minimum UL 555 differential pressure rating of 4-inch w.g.

E. Velocity: Minimum UL 555 velocity rating of 2000 fpm.

F. Construction: Galvanized steel frame in gauges required by manufacturer's UL listing, galvanized curtain style blades mounted outside the air stream, spring closure with Type 301 stainless steel springs, replaceable fusible link, supplied as a single assembly with integral factory sleeve and retaining angles sized to provide installation overlap in accordance with the manufacturer's UL listing.

G. Duct Transition Connection: The Contractor is responsible for selecting and installing the appropriate duct transition.

2.5 SMOKE DAMPERS

A. General: Smoke dampers with airfoil blades meeting the requirements of UL Standard 555S 4th Edition.

B. Leakage: UL 555 S Class II Leakage Rating.

C. Operating Temperature: UL 555S elevated temperature rating of 350 degree F.

D. Differential Pressure: Minimum UL 555S differential pressure rating of 4-inch w.g.

E. Velocity: Minimum UL 555S velocity rating of 2000 fpm.

F. Frame: Structural galvanized steel hat channel. Top and bottom frame members on dampers less than 7-inch high shall be low profile design to maximize the free area of these smaller dampers. Four-piece construction with 1-1/2 inch minimum integral overlapping gusset reinforcements in each corner to assure square corners and provide maximum resistance to racking.

G. Blades: 16 Gauge galvanized steel with full-length structural reinforcement and a double skin airfoil shape. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Provide symmetrical blades of varying size as required to completely fill the damper opening.

H. Blade Stops: Blade stops at top and bottom of damper frame shall occupy no more than 1/2-inch of the damper opening area to allow for maximum free area and to minimize pressure loss across the damper.

I. Linkage: In jamb.

J. Seals: Extruded silicone rubber permanently bonded to the appropriate blade edges.

K. Jamb: Flexible stainless steel compression type.

L. Axles: Minimum 1/2-inch diameter plated steel.

M. Bearings: Stainless steel sleeve type rotating in polished extruded holes in the damper frame.

N. Actuator: Normally closed, 24V, 60 Hz electric motor mounted outside the air stream that meets IBC 15-second operation requirement and is tested for minimum of one (1) year of holding with no evidence of spring return failure.

1. Actuators shall return to fully open (normal) position when reset.
2. Provide actuators as manufactured by Belimo.

O. All factory wiring to be done in accordance with N.E.C. (NFPA 70). Refer to Detail on Drawings; Sequence of Operation on Mechanical Drawing and/or Electrical portion of the Contract Documents for full coordination of equipment and controls. Coordinate actuator mounting arrangement with Drawings (i.e. right or left mounting).

P. Sleeve: Factory supplied as a single assembly with an integral factory sleeve.

Q. Retaining Angles: Factory supplied and sized to provide installation overlap in accordance with the manufacturer's UL listing.

R. Two position indicator switches linked directly to damper blade to remotely indicate damper blade position.

S. Duct Transition Connection: The Contractor is responsible for selecting and installing the appropriate duct transition.

2.6 COMBINATION FIRE/SMOKE DAMPERS

A. General: Fire/Smoke dampers with airfoil blades meeting the requirements of UL Standard 555 6th Edition and 555S 4th Edition.

B. Rating: UL 555 fire resistance rating of 1-1/2 hours.

C. Operating Temperature: UL 555S elevated temperature rating of 250 degree F.

D. Leakage: UL 555S Class II Leakage Rating.

E. Differential Pressure: Minimum UL 555S differential pressure rating of 4-inch w.g.

F. Velocity: Minimum UL 555S velocity rating of 2000 fpm.

G. Frame: Structural galvanized steel hat channel. Top and bottom frame members on dampers less than 7-inch high shall be low profile design to maximize the free area of these smaller dampers. Four-piece construction with 1-1/2 inch minimum integral overlapping gusset reinforcements in each corner to assure square corners and provide maximum resistance to racking.

H. Blades: 16 Gauge galvanized steel with full-length structural reinforcement and a double skin airfoil shape. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Provide symmetrical blades of varying size as required to completely fill the damper opening.

I. Blade Stops: Blade stops at top and bottom of damper frame shall occupy no more than 1/2-inch of the damper opening area to allow for maximum free area and to minimize pressure loss across the damper.

J. Linkage: In jamb.

K. Seals: Extruded silicone rubber permanently bonded to the appropriate blade edges.

L. Jamb: Flexible stainless steel compression type.

M. Axles: Minimum 1/2-inch diameter plated steel.

N. Bearings: Stainless steel sleeve type rotating in polished extruded holes in the damper frame.

O. Actuator: Normally closed, 24V, 60 Hz electric motor mounted outside the air stream that meets IBC 15-second operation requirement and is tested for minimum of one (1) year of holding with no evidence of spring return failure.

1. Actuators shall return to fully open (normal) position when reset.
2. Provide actuators as manufactured by Belimo.

P. Sleeve: Factory supplied as a single assembly with an integral factory sleeve.

Q. Retaining Angles: Factory supplied and sized to provide installation overlap in accordance with the manufacturer's UL listing.

R. Two position indicator switches linked directly to damper blade to remotely indicate damper blade position.

S. Duct Transition Connection: The Contractor is responsible for selecting and installing the appropriate duct transition.

T. All factory wiring to be done in accordance with N.E.C. (NFPA 70). Refer to Detail on Drawings; Sequence of Operation on Mechanical Drawing and/or Electrical portion of the Contract Documents for full coordination of equipment and controls. Coordinate actuator mounting arrangement with Drawings (i.e. right or left mounting).

U. For grilles mounted in rated walls, provide front access dampers.

V. Heat-Activated Temperature Release Device: Control close and lock damper during test, smoke detection, power failure, or fire conditions through actuator closure spring. At no time shall actuator disengage from damper blades. Allow damper to be automatically reset remotely or manually reset locally after test, smoke detection, or power failure. 165 Degree F release temperature.

2.7 TURNING VANES

A. Fabricated Turning Vanes: Provide fabricated 22 gauge, single blade 4-1/2 inch radius, 3-1/4 inch spacing turning vanes and Type 2, 4-1/2 inch wide runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards" Fig 2.3.

B. Manufactured Turning Vanes: Provide single blade turning vanes constructed of 1-1/2 inch wide curved blades set at 3/4-inch O.C., supported with bars perpendicular to blades set at 2-inch O.C., and set into side strips suitable for mounting in ductwork.

C. Do not use trailing edge turning vanes.

2.8 DUCT HARDWARE

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
2. Quadrant Locks: Provide for each manual volume damper, quadrant lock device on one (1) end of shaft; and end bearing plate on other end for damper lengths over 12-inch. Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

2.9 DUCT ACCESS DOORS

A. General: Provide access doors, whether shown or not, at all fire dampers, smoke dampers, temperature control dampers, branch balancing dampers, outside air plenums, inlet of fans, upstream of all duct smoke detectors and all other equipment requiring service and/or access.

B. Construction: Construct of same or greater gauge as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. All access doors shall have gasket and will be air-tight. Provide one (1) side hinged, other side with one (1) handle-type latch for doors 12-inch high and smaller, two (2) handle-type latches for larger doors. For spiral ductwork, use United McGill combination access section type ARF-SD for non-insulated duct systems and type ARF-ID double wall insulated door for insulated ducted systems (all supply ductwork).

2.10 FLEXIBLE CONNECTIONS

A. General: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make air-tight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment. Shelf life shall be verified to not exceed six (6) months. Any sign of cracking on interior or exterior shall be cause for replacement immediately.

B. Use the following product types for each application accordingly:

1. Outdoor Equipment Non-Corrosive Air Systems (Exposed to Weather and Sun): Heavy glass fabric, double-coated with DuPont's HYPALON, non-combustible fabric, fire retardant coating with superb resistance to sunlight, ozone and weather which has documented 20-year-old exposure tests. Fabric shall be 26 ounce per square yard, capable of operating at –10 degree F to 250 degree F, waterproof, air tight, 6-inches wide, complies with NFPA 90 and UL Standard #214. "Ventlon" Model as manufactured by VentFabrics, Inc.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the Engineer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install turning vanes in square or rectangular 90 degree elbows in supply, return and exhaust air systems, and elsewhere as indicated.

C. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

D. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

E. Provide duct access doors whether shown or not for inspection and cleaning before and after all filters, coils, fans, automatic dampers, at fire dampers (minimum 16-inch x 24-inch in ducts larger than 18-inch), fire/smoke dampers, upstream of duct smoke detectors and elsewhere as indicated. Review locations prior to fabrication. Provide multiple access doors for large ductwork to provide adequate reach to equipment.

F. Install fire dampers and smoke dampers in accordance with manufacturer's instructions.

G. Provide fire dampers and smoke dampers at locations shown, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction.

H. Provide balancing dampers on high pressure systems where indicated. Use splitter dampers only where indicated on Drawings.

I. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and equipment subject to forced vibration. Provide matching flanged backing frame with flexible connector where flanged fan connections are provided.

J. Where fire and smoke dampers are installed in fire and smoke rated construction, provide firestopping between fire and fire smoke damper sleeve and substrate.

3.3 FIELD QUALITY CONTROL

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

B. Test every fire and fire/smoke damper for proper operation, provide letter to the Architect/ Engineer certifying this work is complete and all dampers are functioning properly.

3.4 ADJUSTING AND CLEANING

A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.

B. Label access doors in accordance with Division 23 Section "Mechanical Identification".

C. Final positioning of manual dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing".

D. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.5 EXTRA STOCK

A. Furnish extra fusible links to Owner, one (1) link for every ten (10) installed of each temperature range; obtain receipt.

END OF SECTION 233300

SECTION 233413 - AIR HANDLING FANS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of Air Handling Equipment Work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. This Section includes the following types of Air-Handling Equipment:

1. Centrifugal Roof Ventilators

C. Refer to other Division 23 sections for vibration control; control system; sequence of operation; testing, adjusting and balancing.

D. Refer to Division 26 section for the following work; not work of this section.

1. Power supply wiring from power source to power connections at air handling units.

E. Refer to Division 23 section "Mechanical/Electrical Requirements for Mechanical Equipment".

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air handling equipment of types and sizes required, whose products have been in satisfactory use in similar service for not less than three (3) years.

B. Codes and Standards:

1. Fans Performance Ratings: Establish flow rate, pressure, power air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.
2. UL Compliance: Provide air handling equipment which are listed by UL and have UL label affixed.
3. UL Compliance: Provide air handling equipment which are designed, manufactured, and tested in accordance with UL 805 "Power Ventilators".
4. NEMA Compliance: Provide motors and electrical accessories complying with NEMA Standards.
5. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings from Laboratory Test Data". Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating". Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.

6. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be defined in OSHA Regulation 1910.7.
7. Electrical Component Standards: Components and installation shall comply with NFPA 70 "National Electrical Code".

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for air handling equipment including specifications, capacity ratings, sound data, dimensions, weights, materials, operating and service/access clearance accessories furnished, and installation instructions.

B. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, construction details, methods of assembly of components, and field connection details.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to air-handling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are manufacturer-installed and portions to be field-installed.

D. Record Drawings: At project closeout, submit record drawings of installed systems products; in accordance with requirements of Division 1.

E. Maintenance Data: Submit maintenance data and parts list for each type of power and gravity ventilator, accessory, and control. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals in accordance with requirements of Division 1.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Lift and support units with the manufacturer's designated lifting or supporting points.

B. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

C. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad.

B. Coordinate the installation of roof curbs, equipment supports, and roof penetrations.

C. Coordinate the size and location of structural steel support members.

1.6 EXTRA MATERIALS

A. Furnish one (1) additional complete set of belts for each belt-driven fan.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Centrifugal Roof Ventilators:

a. Acme Engineering & Manufacturing Corp.
b. Aerovent, Inc.
c. Carnes Company, Inc.
d. Loren Cook Co.
e. Jenn Co Fan.
f. Penn Barry.
g. Greenheck
h. Twin City Fan & Blower Co. (TCF)

2. Prefabricated Roof Curbs:

a. Louvers & Dampers
b. Custom Curb, Inc.
c. Pate Co.
d. S & L Manufacturing Co.
e. ThyCurb Division; Thybar Corp.

2.2 CENTRIFUGAL ROOF VENTILATORS

A. General Description: Belt-driven or direct-drive as indicated, centrifugal consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

B. Housing: Heavy-gauge, removable, spun-aluminum, dome top and outlet baffle; square, one-piece, hinged, aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

D. Belt-Driven Drive Assembly: Resiliently mou nted to the housing, with the following features:

1. Pulleys: Cast iron, adjustable-pitch.

2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
4. Fan and motor isolated from exhaust air stream.

E. Accessories: The following items are required as indicated:

1. Disconnect Switch: Non-fusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.
2. Bird Screens: Removable 1/2-inch mesh, 16 gauge, aluminum or brass wire.
3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base, factory set to close when fan stops.
4. Roof Curbs: Prefabricated, heavy-gauge, galvanized steel; mitered and welded corners; 2-inch thick, rigid, fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof decks; and 2-inch wood nailer. Size as required to suit roof opening and fan base.

a. Overall Height: 12-Inches above finished roofing.

2.3 PREFABRICATED ROOF CURBS

A. Furnish and install roof curbs as scheduled for duct openings through the roof and for exhaust fan support. The curbs shall be galvanized steel. If the curbs are to have sound attenuation qualities, they shall be not less than those catalogued for the equipment specified.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, housekeeping pads, and other conditions affecting performance of fans.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install fans level and plumb, in accordance with manufacturer's written instructions. Support units using vibration control devices as indicated. Vibration control devices are specified in Division 23 Section "Vibration Controls".

1. Secure roof-mounted fans to roof curbs with cadmium-plated hardware.

a. Installation of roof curbs is specified in Division 7.

B. Arrange installation of units to provide access space around air-handling units for service and maintenance.

3.3 CONNECTIONS

A. Duct installations and connections are specified in other Division 23 sections. Make final duct connections on inlet and outlet duct connections with flexible connections.

B. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Ensure that rotation is in direction indicated and intended for proper performance. Do not proceed with centrifugal fan start-up until wiring installation is acceptable to Centrifugal Fan Installer.
2. Temperature control wiring and interlock wiring are specified in Division 23.
3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.4 FIELD QUALITY CONTROL

A. Upon completion of installation of air handling equipment, and after motor has been energized with normal power source, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected.

B. Manufacturer's Field Inspection: Arrange and pay for a factory-authorized service representative to perform the following:

1. Inspect the field assembly of components and installation of fans including ductwork and electrical connections.
2. Prepare a written report on findings and recommended corrective actions.

3.5 ADJUSTING, CLEANING, AND PROTECTING

A. Start-up, test and adjust air handling equipment in presence of manufacturer's authorized representative.

B. Adjust damper linkages for proper damper operation.

C. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.6 SPARE PARTS

A. General: Furnish to Owner with receipt one (1) spare set of belts for each belt driven air handling equipment.

3.7 PRE-STARTUP CHECK

A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:

1. Remove shipping blocking and bracing.
2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Verify manual and automatic volume control and that fire and smoke dampers in connected ductwork systems are in the full-open position.
7. Disable automatic temperature control operators.

B. Starting Procedures for Fans:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
2. Replace fan and motor pulleys as required to achieve design conditions.
3. Measure and record motor electrical values for voltage and amperage.

C. Shut unit down and reconnect automatic temperature control operators.

D. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for procedures for air-handling-system testing, adjusting, and balancing.

3.8 DEMONSTRATION

A. Demonstration Services: Arrange and pay for a factory-authorized service representative to train Owner's maintenance personnel on the following:

1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 1 Section "Project Closeout" and Division 23 Section "Basic Mechanical Requirements".

B. Schedule training with at least seven (7) days' advance notice.

END OF SECTION 233413

SECTION 233600 - AIR TERMINALS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of Air Terminals Work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of Air Terminals specified in this section include the following:

1. Variable Volume Air Terminals

a. Shutoff Single Duct
b. Reheat
c. Dual-Duct
d. Induction
e. By-Pass

2. Integral Diffuser Terminals

a. Inlet Damper
b. Outlet Damper

3. Fan Powered Terminals
4. Variable or constant volume exhaust terminals.

C. Refer to other Division 23 sections for external insulation of air terminals; testing, adjusting and balancing of air terminals; temperature controls which are to be furnished by others but installed as work of this section.

D. Refer to Division 26 sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on air terminals. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

E. Provide the following electrical work as work of this section, complying with requirements of Division 26 sections:

1. Control wiring between field-installed controls and air terminals.

a. Control wiring specified as work of Division 23 for Automatic Temperature Controls is work of that section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of air terminals with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. ADC Compliance: Provide air terminals which have been tested and rated in accordance with ADC standards, and bear ADC Seal.
2. ARI Compliance: Provide air terminals which have been tested and rated in accordance with ARI 880 "Industry Standard for Air Terminals" and bear ARI certification seal.
3. NFPA Compliance: Construct air terminals using acoustical and thermal insulations complying with NFPA 90A "Air Conditioning and Ventilating Systems".

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including performance and sound data for each size and type of air terminal furnished; schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished; and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Wiring Diagrams: Submit ladder-type wiring diagrams for electric power and control components, clearly indicating required field electrical connections.

D. Record Drawings: At project closeout, submit record drawings of installed systems products, in accordance with requirements of Division 23.

E. Maintenance Data: Submit maintenance data and parts list for each type of air terminal; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings, and maintenance data in maintenance manual; in accordance with requirements of Division 23.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver air terminals wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of air terminal and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in boxes.

B. Store air terminals in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Supply Air Terminals:

a. Carnes Co.
b. Titus Products Division
c. Carrier Corp.
d. Trane (The) Co.
e. Metal-Aire
f. Price
g. Nailor Industries, Inc.
h. Anemostat
i. York/Johnson Controls
j. Krueger

2.2 SUPPLY AIR TERMINALS

A. General: Provide factory-fabricated and tested air terminals as indicated, selected with performance characteristics which match or exceed those indicated on schedule.

B. Air terminal units shall be low pressure drop, single duct throttling type pressure independent and suitable for use in medium pressure air distribution systems.

C. Casing shall be 22 gauge galvanized steel construction with internal acoustical coated 1-inch thick, 1-1/2 lb. density fiberglass insulation, inlet and outlet duct connection and discharge sound attenuator, where scheduled.

1. Air terminal and discharge sound attenuator shall be provided with "Tedlar" non-porous film applied as separation between fiberglass liner and airstream. At corners of casing, cut edges of film shall be sealed with two-bracket interlock.

D. Internal damper blade shall be extruded aluminum or 18 gauge steel with keyed fit shaft and nylon bushing. Damper shall seal against gasketed stops maximum 2 percent leakage at 3.0-inch S.P. All mechanical parts shall be galvanized or non-ferrous.

E. Hot water heating coils shall be designed for 200 psig maximum working pressure and 200 degree F maximum operating temperature. Coil shall be serpentine-type, 2-row minimum, constructed of 1/2-inch O.D. copper tubes mechanically bonded to aluminum fins; galvanized steel casing.

F. Provide factory-installed framed duct access door complete with quarter-turn quick release fasteners in terminal box casing upstream of reheat coil. Access door shall be sized large enough to allow the coil to be inspected and cleaned.

G. Provide label on each air terminal unit, indicating plan designation, unit size, CFM range and settings and calibration curve.

H. Controls shall include wall mounted thermostat, modulating damper, damper operator furnished by the Temperature Control Contractor, and factory installed by the equipment manufacturer, pressure independent pneumatic cross-shaped flow sensor with amplifying total pressure pickup points connected in parallel to a central averaging chamber (an inlet velocity sensor with pickup points connected in series shall not be accepted), for measuring inlet volume. The sensor shall amplify duct velocity pressure by a factor of 1.75 and shall maintain control accuracy with the same size inlet duct in any configuration. Specific control component requirements are specified in Division 23 Section Direct Digital Control Systems.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which air terminals are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF AIR TERMINALS

A. General: Install air terminals as indicated, and in accordance with manufacturer's installation instructions.

B. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain a minimum of 30" clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.

C. Duct Connections: Connect ductwork to air terminals in accordance with Division 23 ductwork sections. Provide minimum 3 duct diameters straight section prior to connection to Air Terminal.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation and prior to initial operation, test and demonstrate that air terminals, and duct connections to air terminals, are leak-tight.

B. Repair or replace air terminals and duct connections as required to eliminate leaks, and retest to demonstrate compliance.

3.4 CLEANING

A. Clean exposed factory-finished surfaces. Repair any marred or scratched surfaces with manufacturers touch-up paint.

END OF SECTION 233600

SECTION 233650 - SOUND ATTENUATORS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Sound Attenuators required by this section are indicated on drawings and schedules, and are not necessarily limited to this section.

B. Refer to other Division 23 sections for ductwork; external insulation of sound attenuators; not work of this section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of sound attenuators with characteristics, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. NFPA Compliance: Construct sound attenuators using acoustical fill complying with NFPA 90A, "Air Conditioning and Ventilating Systems".
2. ASTM Compliances: Comply with applicable requirements the current versions of ASTM E90 and E477.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including performance data for each size and type of sound attenuator furnished; schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished; and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Record Drawings: At project closeout, submit record drawings of installed systems products, in accordance with requirements of Division 1.

D. Maintenance Data: Submit maintenance data and parts list for each type of sound attenuator; including "trouble-shooting" maintenance guide. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver sound attenuators with identification on outside of casings indicating type of sound attenuator and location to be installed. Avoid crushing or bending, and prevent dirt and debris from entering and settling in sound attenuators.

B. Store sound attenuators so as to protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

B. Cross Talk Silencers:

1. Aeroacoustic Corporation
2. Gale Noise Control; Division of Norwood Manufacturing Corp.
3. Tempmaster Corp; Subs. of Temperature Industries Inc.
4. Titus Products; Division of Philips Industries Inc.
5. International Acoustics Company
6. Rink

C. Duct Silencers:

1. Aeroacoustic Corporation
2. Gale Noise Control; Division of Norwood Manufacturing Corp.
3. Titus Products; Division of Philips Industries Inc.
4. International Acoustics Company
5. SEMCO
6. United Sheet Metal
7. Rink
8. Vibro Acoustics
9. Price Industries

2.2 CROSS TALK SILENCERS

A. General: Provide factory-fabricated and tested cross talk silencers as indicated, selected with performance characteristics which match or exceed those indicated on schedule.

B. Construction: Construct outer casing of 22 gauge and interior baffles of 22 gauge galvanized steel. Lock form seams in outer casing. Provide glass fiber acoustical filler material, packed under compression. Construct so entire silencer is incombustible, moisture resistant, and imparts no odors to the ambient air.

C. Pressure Drop: Provide units that have equal or less pressure drop than that scheduled, and certify that static pressure has been measured by independent laboratory in accordance with AMCA 210, "Laboratory Methods of Testing Fans for Rating Purposes".

D. Acoustical Characteristics: Provide units that have equal or greater noise reduction characteristics than those scheduled, and certify that noise reduction data has been measured by independent laboratory in accordance with ASTM E90, "Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions".

2.3 DUCT SILENCERS

A. General: Provide factory-fabricated and tested duct silencers as indicated, select with performance characteristics which match, or exceed those indicated on schedule.

B. Casings: Construct of galvanized sheet metal with gauge and seam construction equal or greater than that recommended by SMACNA Duct Construction Standards for ductwork of same size and pressure class; but not less than 22 gauge for outer casing and 22 gauge for inner casing. All seams shall be lock formed and mastic filled.

C. Acoustic Fill: Provide inorganic mineral or glass fiber filler material, inert, vermin and moisture proof, of sufficient density to obtain specified acoustic performance. Pack under not less than 5 percent compression to eliminate voids due to vibration and settling.

D. Acoustic Performance: Provide silencer ratings that have been determined in duct at reverberative room test facility. Test silencer with air flow in both directions through silencer, in accordance with ASTM E477, "Methods of Testing Duct Liner Materials and Prefabricated Silencers for Acoustical and Airflow Performance".

E. For acoustic ratings, include dynamic insertion loss and self-generated noise power levels for both forward flow (air and noise in same direction) and reverse flow (air and noise in opposite directions) with airflow at the design FPM face velocity.

F. Aerodynamic Performance: Provide silencers with static pressure loss equal to or less than that scheduled.

G. Certification: Provide certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance. Conduct all rating tests at same facility. Open testing facility for inspection by Architect/Engineer if requested.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which sound attenuators are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF SOUND ATTENUATORS

A. General: Install sound attenuators as indicated, and in accordance with manufacturer's installation instructions.

B. Location: Install each unit level and accurately in position indicated in relation to other work; and maintain sufficient clearance for normal service and maintenance, but in no case less than that recommended by manufacturer.

C. Duct Connections: Connect ductwork to sound attenuators in accordance with Division 23 ductwork sections.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation and prior to initial operation, test and demonstrate that sound attenuators, and duct connections to sound attenuators, are leak tight.

B. Repair or replace sound attenuators and duct connections as required to eliminate leaks, and retest to demonstrate compliance.

3.4 CLEANING

A. Clean exposed factory finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 233650

SECTION 233713 - AIR OUTLETS & INLETS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of Air Outlets and Inlets Work is indicated by drawings and schedules, and by requirements of this section.

B. Types of Air Outlets and Inlets required for project include the following:

1. Diffusers
2. Registers and Grilles
3. Louvers

C. Refer to other Division 23 sections for ductwork, duct accessories; testing and balancing; not work of this section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".
2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.
5. AMCA Compliance: Test and rate louvers in accordance with AMCA 500L-99 "Laboratory Method of Testing Louvers for Rating".
6. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
7. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.

2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

C. Record Drawings: At project closeout, submit record drawings of installed systems products, in accordance with requirements of Division 1.

D. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Diffusers, Registers and Grilles:

    a. Anemostat Products Division; Dynamics Corp. of America
    b. Carnes Co.; Division of Wehr Corp.
    c. Krueger; Division of Philips Industries, Inc.
    d. Titus Products Division; Philips Industries, Inc.
    e. Metal-Aire
    f. Nailor Industries, Inc.
    g. E.H. Price.

2. Louvers:

    a. Air Balance
    b. American Warming & Ventilating, Inc.
    c. Arrow United Industries, Inc.
    d. Dowco Corp.

e. Louvers & Dampers, Inc.
f. Penn Ventilator Co., Inc.
g. Ruskin
h. Pottorff
i. Greenheck
j. NCA Industries, Inc.

2.2 AIR DIFFUSERS

A. General: Except as otherwise indicated, provide manufacturer's standard air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Surface (Wall or Ceiling) compatibility: Provide diffusers with border styles that are compatible with adjacent systems, and that are specifically manufactured to fit into surface with accurate fit and adequate support. Refer to general construction drawings and specifications for types of systems which will contain each type of air diffuser.

D. Types: Provide diffusers of type, capacity, and with accessories and finishes as listed on Air Device Schedule.

2.3 REGISTERS AND GRILLES

A. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction which will contain each type of wall register and grille.

D. Types: Provide registers and grilles of type, capacity, and with accessories and finishes as listed on air device schedule.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling modules.

3.3 SPARE PARTS

A. Furnish to Owner, with receipt, three (3) operating keys for each type of air outlet and inlet that require them.

END OF SECTION 233713

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

B. Refer to other Division 23 sections for metal ductwork, air devices, automatic temperature controls not factory-installed, and required for conjunction with packaged heating and cooling units; not work of this section.

C. Electrical Work: Refer to Division 23 section "Electrical Provisions of Mechanical Work" for requirements.

1.3 REFRIGERANTS

A. All refrigerants used for each condensing unit shall be on the latest EPA list of approved refrigerants and environmentally friendly.

B. No CFC or HCFC based refrigerants shall be used.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. LEED Submittals:

1. Product Data for Credit EA 4: For refrigerants, documentation including printed statement that refrigerants are free of HCFCs.

C. 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. Clearly differentiate between portions of wiring that are factory-installed and portions that are to be field-installed.

2. Wiring Diagrams: For power, signal, and control wiring.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Field quality-control reports.

F. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

G. Warranty: Sample of special warranty.

H. Record Drawings: At project closeout, submit record drawings of installed systems products in accordance with requirements of Division 1.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of rooftop heating and cooling units, of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-Up."

D. ASHRAE/IESNA Compliance:

1. Applicable requirements in ASHRAE/IESNA 90.1-2009.
2. Energy Efficiency Ratio (EER) of equipment shall be equal to or greater than prescribed by ASHRAE 90.1 A, "Energy Conservation in New Building Design."

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: One year(s) from date of Substantial Completion.
b. For Parts: One year(s) from date of Substantial Completion.
c. For Labor: One year(s) from date of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handle units and components carefully to prevent damage. Replace damaged units or components with new.

B. Store units and components in clean dry place, off the ground, and protect from weather, water, and physical damage.

C. Rig units to comply with manufacturer's rigging and installation instructions for unloading units, and moving them to final location.

1.9 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. Filters: One set(s) for each air-handling unit.
2. Gaskets: One set(s) for each access door.
3. Fan Belts: One set(s) for each air-handling unit fan.

1.10 SCHEDULING AND SEQUENCING

A. Coordinate installation of roof mounting curb with roof structure.

B. Coordinate roof opening locations and for mechanical and electrical connections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or equal product by one of the following:

1. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
2. SANYO North America Corporation; SANYO Fisher Company.
3. Toshiba
4. Carrier
5. LG.
6. Panasonic
7. Daikin

2.2 INDOOR UNITS 5 TONS OR LESS

A. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
3. Fan: Direct drive, centrifugal.
4. Fan Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
    b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    c. Enclosure Type: Totally enclosed, fan cooled.
    d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
    e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.
    f. Mount unit-mounted disconnect switches on exterior of unit.

5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
6. Condensate Drain Pans:

    a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

        1) Length: Extend drain pan downstream from leaving face.
        2) Depth: A minimum of 1 inch deep.

    b. Single-wall, stainless-steel sheet.
    c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

        1) Minimum Connection Size: NPS 1.
    d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
    e. Provide water detection device (safe-t-switch or similar) in the drain pan to shut unit down if primary drain becomes blocked.

7. Air Filtration Section:

   a. General Requirements for Air Filtration Section:

      1) Comply with NFPA 90A.
      2) Minimum Arrestance: According to ASHRAE 52.1 and MERV-A according to ASHRAE 52.2, Appendix J.
      3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

   b. Disposable Panel Filters:

      1) Factory-fabricated, viscous-coated, flat-panel type.
      2) Thickness: 1 inch.
      3) Media: Interlaced glass fibers sprayed with nonflammable adhesive.
      4) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

   a. Compressor Type: Scroll.
   b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
   c. Refrigerant Charge: R-410A.
   d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.

3. Fan: Aluminum-propeller type, directly connected to motor.
4. Motor: Permanently lubricated, with integral thermal-overload protection.
5. Low Ambient Kit: Permits operation down to **[45]** deg F.
6. Mounting Base: Polyethylene.

2.4 ACCESSORIES

A. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.

3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection including auto setting.

B. Automatic-reset timer to prevent rapid cycling of compressor.

C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

D. Drain Hose: For condensate.

E. Integral condensate Pump.

2.5 CAPACITIES AND CHARACTERISTICS

A. See Equipment Schedule on Plans for capacities.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports specified in Division 07 Section "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

D. Install seismic restraints, per Code.

E. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch.

F. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. 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.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
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.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

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SECTION 238200 - TERMINAL HEAT UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of Terminal Unit Work is indicated on drawings and schedules, and by requirements of this section.

B. Types of Terminal Units required for project include the following:

1. Cabinet Unit Heaters
2. Electric Cabinet Heaters

C. Refer to other Division 23 sections for piping; ductwork; testing, adjusting and balancing of terminal units; not work of this section.

D. Refer to Division 26 section for the following work; not work of this section.

1. Power supply wiring from power source to power connection on terminal units.
2. Provide the following electrical work as work of this section, complying with requirements of Division 26 sections:

    a. Control wiring between field-installed controls, indicating devices, and terminal unit control panels.

        1) Control wiring specified as work of Division 23 for Automatic Temperature Controls is work of that section.

E. Refer to other Division 23 sections for automatic temperature controls not factory installed, required in conjunction with terminal units; not work of this section.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of terminal units, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. I=B=R Compliance: Test and rate baseboard and finned tube radiation in accordance with I=B=R, provide published ratings bearing emblem of I=B=R.
2. ARI Compliance: Provide coil ratings in accordance with ARI Standard 410 "Forced-Circulation Air-Cooling and Air-Heating Coils".
3. ASHRAE Compliance: Test coils in accordance with ASHRAE Standard 33 "Methods of Testing Forced Circulation Air Cooling and Heating Coils".
4. ARI Compliance: Test and rate fan-coil units in accordance with ARI Standard 440 "Room Fan-Coil Air Conditioners".

5. UL Compliance: Construct and install fan-coil units in compliance with UL 883 "Safety Standards for Fan Coil Units and Room Fan Heater Units".
6. UL Compliance: Provide electrical components for terminal units which have been listed and labeled by UL.
7. ARI Compliance: Test and rate ventilators in accordance with ARI Standard 330 "Unit Ventilators".
8. Electric Heating Equipment: All equipment with a heating coil capacity exceeding a 48 amp rating shall have the heating elements subdivided and protected by an overcurrent protection device rated at not more than 60 amps. Equipment not exceeding 48 amps shall also have overcurrent protection. Overcurrent protection devices shall be factory wired and installed in accordance with the National Electric Code. All equipment shall be factory assembled and wired in accordance with the National Fire Protection Association and shall be listed by Underwriters' Laboratories.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, for terminal units showing dimensions, capacities, ratings, performance characteristics, gauges and finishes of materials, and installation-startup instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating terminal unit dimensions, weight loading, required clearances, construction details, field connection details and methods of assembly of components.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to terminal units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Record Drawings: At project closeout, submit record drawings of installed systems products in accordance with requirements of Division 1.

E. Maintenance Data: Submit maintenance instructions, including lubrication instructions, filter replacement, motor and drive replacement, control, accessories, "trouble-shooting" maintenance guide, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Handle terminal units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged terminal units or components; replace with new.

B. Store terminal units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with Manufacturer's rigging and installation instructions for unloading terminal units, and moving them to final location.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Cabinet Unit Heaters:

a. Airtherm Mfg. Co.
b. Daikin.
c. Modine Mfg. Co.
d. Trane (The) Co.
e. Young Radiator Co.
f. Vulcan Radiator Corp.
g. Rittling

2. Electric Cabinet Heaters:

a. Airtherm
b. Q Mark
c. Trane (The) Co.
d. Berko
e. Markel
f. Singer

3. Electric Wall Heaters:

a. Berko
b. Q Mark
c. Singer
d. Brasch
e. Markel

2.2 CABINET UNIT HEATERS

A. General: Provide hot water cabinet heaters having cabinet sizes and in locations as indicated, and of capacities, style, and having accessories as scheduled. Include in basic unit chassis, coil, fanboard, fan wheels, housings, motor, and insulation.

B. Chassis: Galvanized steel wrap-around structural frame with edges flanged.

C. Insulation: Faced, heavy density glass fiber.

D. Cabinet: 16 Gauge removable front panel, 18 gauge top and side panels. Insulate front panel over entire coil section. Provide access door on coil connection side. Clean cabinet parts, bonderize, phosphatize, and flow-coat with standard factory color selected baked enamel finish.

E. Water Coils: Construct of 5/8-inch seamless copper tubes mechanically bonded to configurated aluminum fins. Design for 300 psi and leak test at 300 psi under water. Provide same end connections for supply and return.

F. Steam Coils: Construct of 1-inch seamless copper tubes mechanically bonded to configurated aluminum fins. Design for 75 psi and leak test at 450 psi under water. Provide cast iron headers, and same end connections for supply and return.

G. Fans: Provide centrifugal, forward curved double width fan wheels constructed of non-corrosive, molded, fiberglass-reinforced thermoplastic material. Construct fan scrolls of galvanized steel.

H. Motors: Provide shaded pole motors with integral thermal overload protection, and motor cords for plug-in to junction box in unit.

I. Filters: Provide replaceable "sock" type filters. Provide tack-welded wire frame custom made for CUH to replace factory filters.

J. Accessories: Provide the following accessories as indicated and/or scheduled:

1. Wall Boxes: Provide aluminum wall boxes with integral eliminators and insect screen.
2. Recessing Flanges: Provide 18 gauge steel flanges for recessing cabinet heaters into wall or ceiling.
3. Sub-bases: Provide 18 gauge steel sub-base for vertical units, height as indicated.
4. Extended Oilers: Provide plastic motor oiler tubes extending to beneath top discharge grille.

2.3 ELECTRIC CABINET HEATERS

A. General: Provide electric cabinet heaters having cabinet sizes and in locations as indicated, and of capacities, style, and having accessories as scheduled. Include in basic unit chassis, coil, fanboard, fan wheels, housings, motor, and insulation.

B. Chassis: Galvanized steel wrap-around structural frame with edges flanged.

C. Insulation: Faced, heavy density glass fiber.

D. Cabinet: 16 Gauge removable front panel, 8 gauge top and side panels. Insulate front panel over entire coil section. Provide access door on coil connection side. Clean cabinet parts, bonderize, phosphatize, and flow-coat with standard factory color selected baked enamel finish.

E. Electric Element: Electric resistance element with manual-reset thermal overload protection unit mounted thermostat.

F. Fans: Provide centrifugal, forward curved double width fan wheels constructed of non-corrosive, molded, fiberglass-reinforced thermoplastic material. Construct fan scrolls of galvanized steel.

G. Motors: Provide shaded pole motors with integral thermal over-load protection, and motor cords for plug-in to junction box in unit.

H. Filters: Provide 1-inch thick throwaway type filters in fiberboard frames.

I. Accessories: Provide the following accessories as indicated and/or scheduled.

1. Wall Boxes: Provide aluminum wall boxes with integral eliminators and insect screen.
2. Recessing Flanges: Provide 18 gauge steel flanges for recessing cabinet heaters into wall or ceiling.
3. Sub-Bases: Provide 18 gauge steel sub-base for vertical units, height as indicated.

2.4 ELECTRIC WALL HEATERS

A. Unit shall include electric resistance type heating elements concealed adjustable thermostat, concealed electrical connections, line voltage disconnect enclosed fan motor, and wall box.

B. Unit shall be standard color baked enamel finish.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which terminal units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 ELECTRICAL WIRING

A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.
1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment Installer.

3.3 ADJUSTING AND CLEANING

A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.

B. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

C. Install new filter units for terminals requiring same.

Boulder County Building Services Division

JUSTICE CENTER DA INFILL

1777 6th St.
Boulder, CO 80302
CONSTRUCTION DOCUMENTS

PROJECT DIRCTORY

OWNER

Boulder County
Building Services Devision
2020 13th Street
Boulder, Colorado 80302
33.441.3925

ARCHITECT / LANDSCAPE

Short Elliott Hendrickson, Inc.
2000 South Colorado Boulevard
Tower One, Suite 6000
Denver, Colorado 80222
720.540.6800

CIVIL / STRUCTURAL

JVA, Inc.
1319 Spruce St.
Boulder, Colorado 80302
303.444.1951

MEP ENGINEER

BCER Engineering, Inc.
5420 Ward Rd.
Arvada, Colorado 80002
303.422.7400

DRAWING INDEX

GENERAL

CIVIL

LANDSCAPE

ARCHITECTURAL △1

STRUCTURAL

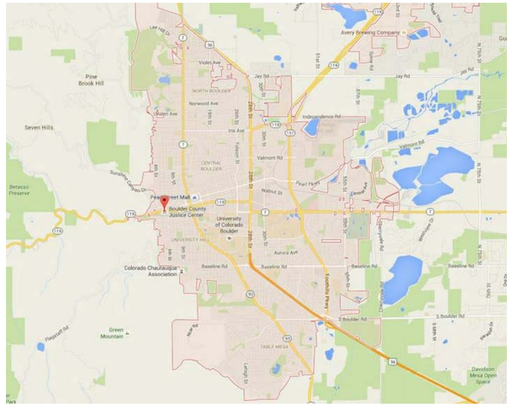
MECHANICAL

PLUMBING

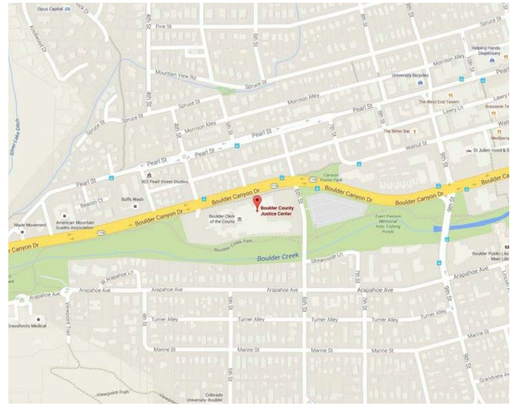
FIRE PROTECTION

ELECTRICAL

VICINITY MAP



LOCATION MAP



SEH
Building a Better World for All of Us®

STATE OF COLORADO
ROBERT LEWIS EKSTROM
400982
LICENSED ARCHITECT

Owner
Boulder County
Building Services Division
2020 13th Street
Boulder, Colorado 80302
303.441.3925

Architect / Landscape
Short Elliott Hendrickson, Inc.
2000 South Colorado Boulevard
Tower One, Suite 6000
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Boulder County Building Services Division

JUSTICE CENTER DA INFILL

1777 6th St.
Boulder, CO 80302

SEH Project	135948
Project Manager	RE
Drawn By	CS/NM/TM

Project Status	Issue Date
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date
1	ADDENDUM 2	01/16/2018

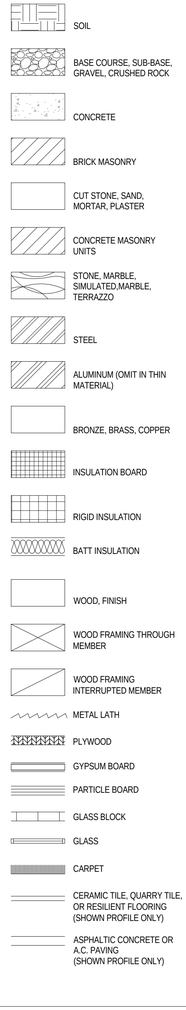
GENERAL INFORMATION / SHEET INDEX

G
001

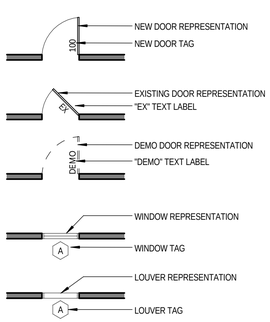
ABBREVIATIONS

&	AND
L	ANGLE
@	AT
℄	CENTERLINE
Ø	DIAMETER/ROUND
(E)	EXISTING
#	POUND/NUMBER
+/-	PLUS OR MINUS
℔	PROPERTY LINE
SQ	SQUARE
A/C	AIR CONDITIONING
A.B.	ANCHOR BOLT
ABV.	ABOVE
A.C.	ASPHALTIC CONCRETE
ACC.	ACCESSIBLE
ACOUS.	ACOUSTICAL
A.D.	AREA DRAIN
	ACCESS DOOR
ADD.	ADDENDUM
ADJ.	ADJUSTABLE
ADJA.	ADJACENT
A.F.	ACCESS FLOOR
A.F.F.	ABOVE FINISH FLOOR
AGGR.	AGGREGATE
A.H.U.	AIR HANDLING UNIT
ALUM.	ALUMINUM
ALT.	ALTER OR ALTERNATE
ANG.	ANGLE
ANOD.	ANODIZED
A.P.	ACCESS PANEL
APPROX.	APPROXIMATE
ARCH.	ARCHITECTURAL
ASPH.	ASPHALT (PAVING)
A.T.	ACOUSTIC TILE
A.W.	ARCHITECTURAL WOODWORK
BD.	BOARD
BITUM.	BITUMINOUS
BLDG.	BUILDING
BLK.	BLOCK
BLKG.	BLOCKING
BM.	BEAM
B.O.H.	BACK OF HOUSE
BOT.	BOTTOM
BR.	BEDROOM
BRG.	BEARING
BRKT.	BRACKET
B.S.	BOTH SIDES
BSMT.	BASEMENT
BTWN.	BETWEEN
B.U.R.	BUILT-UP ROOFING
C	CHORD/COMPACT
CAB.	CABINET
C.B.	CATCH BASIN
C.B.B.	CEMENTITIOUS BACKER BOARD
C.C.T.V.	CLOSED CIRCUIT TELEVISION
C.D.	CEILING DIFFUSER
CEM.	CEMENT
CER.	CERAMIC
C.F./C.I.	CONTRACTOR FURNISHED CONTRACTOR INSTALLED
C.F.M.	CUBIC FEET PER MINUTE
C.G.	CORNER GUARD
CHAN.	CHANNEL
CH.W.R.	CHILLED WATER RETURN
CH.W.S.	CHILLED WATER SUPPLY
C.I.	CAST IRON
C.I.P.	CAST-IN-PLACE
CIRC.	CIRCULATING
C.J.	CONTROL JOINT
CLNG.	CEILING
CLO.	CLOSET
CLR.	CLEAR
CM.	CENTIMETER
C.M.U.	CONCRETE MASONRY UNIT
CNTR.	COUNTER
C.O.	CLEANOUT/CASED OPENING /CONCRETE OPENING
COL.	COLUMN
COMM.	COMMUNICTATION
COMP.	COMPARTMENT
CONC.	CONCRETE
COND.	CONDITION
CONN.	CONNECTION
CONSTR.	CONSTRUCTION
CONT.	CONTINUOUS
CONTR.	CONTRACTOR
COOR.	COORDINATE
CORR.	CORRIDOR
C.O.T.G.	CLEAN OUT TO GRADE
CP.	CARPET
C.R.	CLOSET ROD
C.R.M.	CONCRETE RUBBLE MASONRY
C.T.	CERAMIC TILE
CTR.	CENTER
CTSK.	COUNTERSUNK
CUST.	CUSTOM
C.W.	COLD WATER
C.W.R.	COLD WATER RETURN
d	PENNY (NAILS)
D.	DEEP/DEPTH/DRYER
D.A.	DOUBLE ACTING
DBL.	DOUBLE
D.D.	DECK DRAIN
DEPT.	DEPARTMENT
DET.	DETAIL
D.F.	DRINKING FOUNTAIN
DIA.	DIAMETER
DIAG.	DIAGONAL
DIM.	DIMENSION
DISP.	DISPENSER
DN.	DOWN
D.O.	DOOR OPENING
D.PTN.	DEMOUNTABLE PARTITION
DR.	DOOR
DS.	DOWNSPOUT
D.SP.	DRY STANDPIPE
DW.	DISHWASHER
DWG.	DRAWING
DWR.	DRAWER
E.	EAST
EA.	EACH
E.A.R.	EXHAUST AIR REGISTER
E.C.	ELASTOMERIC COATING/ EXPOSED CONSTRUCTION
E.F.	EXHAUST FAN
E.F.S.	EXTERIOR FINISH SYSTEM
E.G.C.B.	EXTERIOR GYPSUM CEILING BOARD
E.G.S.B.	EXTERIOR GYPSUM SHEATHING BOARD
E.I.F.S.	EXTERIOR INSULATION & FINISH SYSTEM
E.J.	EXPANSION JOINT
EL.	ELEVATION
ELAS.	ELASTOMERIC
ELEC.	ELECTRICAL
ELEV.	ELEVATOR
EMER.	EMERGENCY
ENCL.	ENCLOSURE
E.O.S.	EDGE OF SLAB
E.P.	ELECTRIC PANEL
EQ.	EQUAL
EQPT.	EQUIPMENT
E.W.	EACH WAY
E.W.C.	ELECTRIC WATER COOLER
EXH.	EXHAUST
EXP.	EXPANSION
EXPO.	EXPOSED
EXIST.	EXISTING
EXT.	EXTERIOR
F.	FEMALE
F.A.	FIRE ALARM
FAB.	FABRICATE
F.A.M.	FLUID APPLIED MEMBRANE
F.B.	FLAT BAR
F.C.O.	FLOOR CLEAN OUT
F.C.U.	FAN COIL UNIT
F.D.	FLOOR DRAIN/ FIRE DAMPER
F.E.	FIRE EXTINGUISHER
F.E.C.	FIRE EXTINGUISHER CABINET
F.F.&E.	FURNITURE, FIXTURE & EQUIPMENT
F.F.S.	FINISH FLOOR SEPARATION
F.H.	FLAT HEAD
F.H.C.	FIRE HOSE CABINET
FIN.	FINISH
FIXT.	FIXTURE
FLASH.	FLASHING
FLDG.	FOLDING
FLG.	FLOORING
FLR.	FLOOR
FLUOR.	FLUORESCENT
F.N.D.	FEMININE NAPKIN DISPOSAL
F.N.V.	FEMININE NAPKIN VENDOR
FND.	FOUNDATION
F.O.	FACE OF ...
F.O.C.	FACE OF CONCRETE
F.O.F.	FACE OF FINISH
F.O.M.	FACE OF MASONRY
F.O.S.	FACE OF SLAB/ FACE OF STUD
F.O.W.	FACE OF WALL
FR.	FRAME
F.R.G.	FIBER REINFORCED GYPSUM
F.R.P.	FIBERGLASS REINFORCED POLYESTER
F.R.T.	FIRE RETARDANT TREATED WOOD
FRZ.	FREEZER
F.S.	FLOOR SINK/FULL SIZE
FT.	FOOT/FEET
F.T.D.	FACIAL TISSUE DISPENSER
FTG.	FOOTING
FURR.	FURRING/FURRED
FUT.	FUTURE
G.	GAS (PIPE)
GA.	GAGE
GAL.	GALLON
GALV.	GALVANIZED
G.B.	GRAB BAR
GEN.	GENERATOR
G.F.I.	GROUND FAULT INTERCEPTOR
G.F.R.C.	GLASS FIBER REINFORCED CONCRETE
GL.	GLASS
GLU-LAM	GLUED LAMINATED WOOD
GND.	GROUND
G.P.H.	GALLONS PER HOUR
G.S.B.	GYPSUM SHEATHING BOARD
GYP.	GYPSUM
H.	HEIGHT/HIGH
H.B.	HOSE BIB
H.C.	HOLLOW CORE
HCP.	HANDICAPPED
HD.	HEAD
HDWD.	HARDWOOD
HDWE.	HARDWARE
H.M.	HOLLOW METAL
HORIZ.	HORIZONTAL
HR.	HOUR
H.S.	HAND SINK
HT.	HEIGHT
HTR.	HEATER
H.V.A.C.	HEATING, VENTILATION AND AIR CONDITIONING
H.W.	HOT WATER
H.W.R.	HOT WATER RETURN
I.D.	INSIDE DIAMETER (DIMENSION)
IN.	INCH
INCL.	INCLUDED/INCLUSIVE/ INCLUDING
INSUL.	INSULATION
INT.	INTERIOR
INV.	INVERT
JAL.	JALOUSIE
JAN.	JANITOR
J.B.	JUNCTION BOX
JST.	JOIST
JT.	JOINT
K.D.	KNOCK DOWN
KG.	KILOGRAM
KIT.	KITCHEN
KM.	KILOMETER
K.O.	KNOCK-OUT
KW.	KILOWATT
L.	LENGTH/LONG
LAB.	LABORATORY
LAM.	LAMINATE/LAMINATED
LAV.	LAVATORY
LB.	POUND
L.F.	LINEAL FOOT
LIQ.	LIQUOR
LKR.	LOCKER
LOC.	LOCATION
L.P.	LAMINATED PLASTIC
LTG.	LIGHTING
LVR.	LOUVER
M.	MALE
MAT'L.	MATERIAL
MAX.	MAXIMUM
M.B.	MACHINE BOLT
M.C.	MEDICINE CABINET
MECH.	MECHANICAL
MEMB.	MEMBRANE
MET.	METAL
MFR.	MANUFACTURER
MH.	MANHOLE
MIN.	MINIMUM
MIR.	MIRROR
MISC.	MISCELLANEOUS
MLDG.	MOULDING
MM.	MILLIMETER
M.O.	MASONRY OPENING
MOD.	MODULAR
M.R.	MOISTURE RESISTANT
MTD.	MOUNTED
MTG.	MOUNTING
N.	NORTH
N.I.C.	NOT IN CONTRACT
NLT.	NIGHT LIGHT
NO.	NUMBER
NOM.	NOMINAL
N.S.	NO SCALE
N.T.S.	NOT TO SCALE
O.	OVER
O.C.	ON CENTER
OA.	OVERALL
O.A.G.	OUTSIDE AIR GRILLE
OBS.	OBSCURE
O.D.	OUTSIDE DIAMETER (DIMENSION)
O.F./C.I.	OWNER FURNISHED/ CONTRACTOR INSTALLED
OFD.	OVERFLOW DRAIN
OFF.	OFFICE
O.F./O.I.	OWNER FURNISHED/ OWNER INSTALLED
OPNG.	OPENING
OPP.	OPPOSITE
OPQ.	OPAQUE
OPR.	OPERABLE
OVHD.	OVERHEAD
PASS.	PASSAGE
P.C.	POST CONTRACT
P.C.A.	POST CONTRACT ARCHITECTURAL PIECE
P.D.	PLANTER DRAIN
PERIM.	PERIMETER
PERP.	PERPENDICULAR
PH.	PENTHOUSE
P.I.P.	POURED-IN-PLACE
PL.	PLATE
PLAM.	PLASTIC LAMINATE
PLAS.	PLASTER
PLBG.	PLUMBING
PLYWD.	PLYWOOD
PNL.	PANEL
PR.	PAIR
P.R.B.P.	PRESSURE REDUCING BACK FLOW PREVENTER
PRCST.	PRECAST
PREFAB.	PREFABRICATED
PREP.	PREPARATION
PROP.	PROPERTY
P.R.V.	PRESSURE RELIEF VALVE
P.S.F.	POUNDS PER SQUARE FOOT
PT.	PAINT/POINT
P.T.D.	PAPER TOWEL DISPENSER
P.T.D.R.	PAPER TOWEL DISPENSER & RECEPTACLE
PTN.	PARTITION
P.T.R.	PAPER TOWEL RECEPTACLE
PVC	POLY VINYL CHLORIDE
Q.T.	QUARRY TILE
R.	RISER
RAD.	RADIUS
R.B.	RESILIENT BASE
RB.HK.	ROBE HOOK
R.C.P.	REFLECTED CEILING PLAN
R.D.	ROOF DRAIN
REBAR	REINFORCING BAR
REF.	REFERENCE/REFER
REFL.	REFLECTOR
REFR.	REFRIGERATOR
REINF.	REINFORCED/REINFORCING
REQ.	REQUIRED
RESIL.	RESILIENT
REST.	RESTROOM
REV.	REVISED/REVISION
R.F.	RESILIENT FLOORING
RFG.	ROOFING
RGTR.	REGISTER
R.H.	ROUND HEAD
RLG.	RAILING
RM.	ROOM
R.O.	ROUGH OPENING
R.W.R.	RECESSED WASTE RECEPTACLE
RWD.	REDWOOD
R.W.L.	RAIN WATER LEADER
S.	SOUTH
S.A.	SINGLE ACTING
S.C.	SOLID CORE
SC.	SCALE
SCHED.	SCHEDULE
SCP.	SCUPPER
S.C.R.	SHOWER CURTAIN ROD
S.D.	SMOKE DETECTOR
SECT.	SECTION
S.F.	SQUARE FEET
SH.	SHELF
SHR.	SHOWER
SHT.	SHEET
SHTG.	SHEATHING
SIM.	SIMILAR
SL.	SLOPE
SLDG.	SLIDING
SLNT.	SEALANT
S.M.	SQUARE METER
S.MH.	SEWER MANHOLE
S.N.D.	SANITARY NAPKIN DISPENSER
S.N.R.	SANITARY NAPKIN RECEPTACLE
S.P.	SOLID PLASTIC
SPEC.	SPECIFICATIONS
SPKR.	SPEAKER
SPRK.	SPRINKLER
SQ.	SQUARE
S.SK.	SERVICE SINK
S.STL.	STAINLESS STEEL
ST.	STONE
STA.	STATION
STD.	STANDARD
STL.	STEEL
STOR.	STORAGE
STRUCT.	STRUCTURE/STRUCTURAL
SURR.	SURROUND
SUSP.	SUSPEND/SUSPENDED
SVC.	SERVICE
SW.	SWITCH
SYM.	SYMETRICAL
SYS.	SYSTEM
T.	TREAD
T&G	TONGUE AND GROOVE
T./S.	TUB/SHOWER
TACKBD.	TACKBOARD
T.B.	TOWEL BAR
T.D.	TRENCH DRAIN
TEL.	TELEPHONE
TEMP.	TEMPERED/TEMPORARY
TER.	TERRAZZO
TFMR.	TRANSFORMER
THK.	THICK/THICKNESS
THR.	THRESHOLD
TLT.	TOILET
T.O.	TOP OF ...
T.O.C.	TOP OF CURB
T.O.F.	TOP OF FLOOR
T.O.P.	TOP OF PARAPET/ TOP OF PAVEMENT
T.O.S.	TOP OF STEEL/ TOP OF SLAB
T.O.W.	TOP OF WALL
T.P.B.	TELEPHONE POWER BOARD
T.P.D.	TOILET PAPER DISPENSER
T.P.H.	TOILET PAPER HOLDER
TRAN.	TRANSITION
TRANS.	TRANSPARENT
T.S.	TUBE STEEL
T.S.C.D.	TOILET SEAT COVER DISPENSER
T.SH.	TOWEL SHELF
TV.	TELEVISION
TYP.	TYPICAL
UC.	UNDERCUT
U.L.	UNDERWRITERS LABORATORIES, INC.
UNF.	UNFINISHED
U.N.O.	UNLESS NOTED OTHERWISE
U.P.	UPHOLSTERED PANELS
UR.	URINAL
VAL.	VALANCE
VAR.	VARIES
V.C.T.	VINYL COMPOSITION TILE
VERT.	VERTICAL
VEST.	VESTIBULE
VLV.	VALVE
VOL.	VOLUME
V.P.	VENEER PLASTER
V.T.R.	VENT THROUGH ROOF
W.	WEST/WIDTH/WIDE/WASHER
W/	WITH
W/O	WITHOUT
W.C.	WATER CLOSET
WC.	WALLCOVERING
WD.	WOOD
WD.P.	WOOD PANELING
WDW.	WINDOW
W.GL.	WIRE GLASS
W.H.	WATER HEATER WARNOCK HERSEY
W.O.	WHERE OCCURS/ WINDOW OPENING
WP.	WATERPROOF
WP.M.	WATERPROOF MEMBRANE
W.S.	WOOD SCREWS
W.R.	WATER RESISTANT
WRB.	WARDROBE
WSCT.	WAINSCOT
W.S.P.	WET STAND PIPE
WT.	WEIGHT
W.W.F.	WELDED WIRE FABRIC

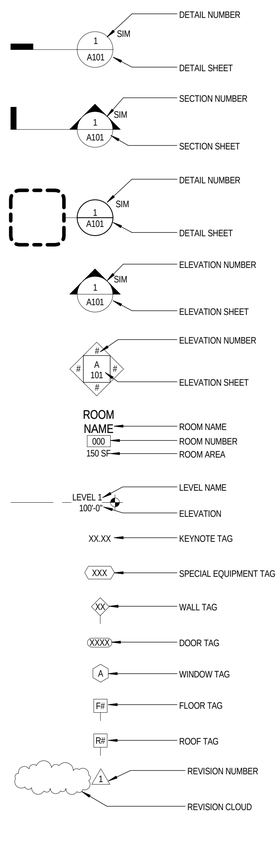
MATERIAL SYMBOLS



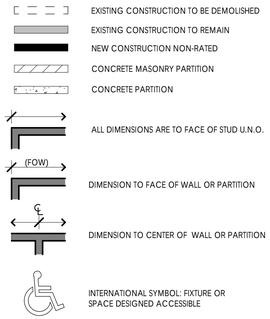
OPENING SYMBOLS



CALLOUT SYMBOLS

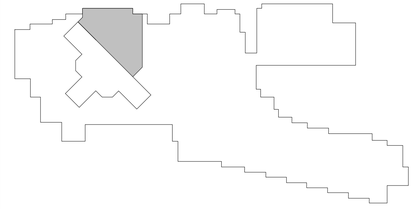


GENERAL SYMBOLS



GENERAL NOTES

1. THESE DRAWINGS ARE LEGAL INSTRUMENTS OF SERVICE FOR THE USE OF THE OWNER AND ITS AUTHORIZED AGENTS AND VENDORS ON THE DESIGNATED PROJECT ONLY.
2. GC RESPONSIBLE FOR KNOWLEDGE OF RELATIVE INFORMATION CONTAINED IN THESE DOCUMENTS AND THE CONDITIONS UNDER WHICH THE WORK WILL BE PERFORMED.
3. CAREFULLY AND THOROUGHLY EXAMINE THE PROJECT SITE, FIELD VERIFY ALL CONDITIONS, GRADES, ELEVATIONS AND DIMENSIONS OF THE VARIOUS FEATURES OF THE SITE AND COMPARE DRAWINGS WITH THE EXISTING CONDITIONS. ANY DISCREPANCIES AND/OR CONDITIONS NEEDING CLARIFICATION SHALL BE REPORTED IN WRITING TO THE ARCHITECT BEFORE STARTING WORK.
4. ALL CONSTRUCTION, FABRICATION AND INSTALLATION SHALL CONFORM TO THE LATEST LOCALLY ADOPTED EDITIONS OF THE IBC, IPC, IMC, NEC, NFPA, OSHA AND ANY FEDERAL, STATE AND LOCAL CODES, REGULATIONS, STANDARDS AND ORDINANCES OF GOVERNING AGENCIES HAVING JURISDICTION. SUCH APPLICABLE CODES, ETC. ARE THOSE WHICH ARE IN EFFECT AT THE TIME THE PROJECT PERMIT APPLICATION IS RECORDED.
5. ALL TRADES ARE CONSIDERED SPECIALISTS IN THEIR RESPECTIVE FIELD/TRADE AND SHALL, BEFORE SUBMISSION OF BID OR PERFORMANCE OF WORK, NOTIFY THE CONTRACTOR IN WRITING OF ANY WORK ON THE DRAWINGS OR IN THE SPECIFICATIONS WHICH CANNOT BE FULLY WARRANTED OR CONSTRUCTED AS DETAILED OR SPECIFIED. THE CONTRACTOR WILL NOTIFY THE ARCHITECT OF SUCH CONDITIONS IN WRITING.
6. DUE TO REPRODUCTIVE PROCESSES, DRAWINGS MAY NOT BE ACCURATE TO SCALE. ALL DIMENSIONS SHALL TAKE PRECEDENCE OVER SCALE SHOWN AND IN NO CASE SHALL WORKING DIMENSIONS BE SCALED FROM PLANS, SECTIONS, ELEVATIONS OR DETAILS.
7. THE STRUCTURAL, MECHANICAL, PLUMBING, AND ELECTRICAL DRAWINGS ARE SUPPLEMENTARY TO THE ARCHITECTURAL DRAWINGS. DISCREPANCIES BETWEEN THE VARIOUS DRAWINGS SHALL BE REPORTED BY THE CONTRACTOR TO THE ARCHITECT IN WRITING.
8. BEFORE STARTING WORK, COORDINATE WITH THE OWNER'S REPRESENTATIVE FOR INSTALLATION OF EQUIPMENT INDICATED N.I.C. ON DRAWINGS. VERIFY EQUIPMENT LOCATIONS WITH THE OWNER'S PRESENTATIVE. VERIFY DIMENSIONS, UTILITIES, ETC, WITH EQUIPMENT MANUFACTURERS ROUGH -- IN DATA PRIOR TO FORMING THE SLAB.
9. PRODUCTS AND MANUFACTURED ITEMS SHALL BE PROVIDED AS SPECIFIED. SUBSTITUTIONS WILL BE PERMITTED IN ACCORDANCE WITH THE PROCEEDURES OUTLINED IN THE SPECIFICATIONS.
10. WHERE DETAILS ARE NOT SHOWN OR NOTED, GC IS TO PROVIDE A WRITTEN REQUEST FOR INFORMATION TO CLARIFY SPECIFIC DETAIL CONDITIONS.
11. ALL INDICATED EXISTING UTILITIES OR STRUCTURES ARE BASED ON INFORMATION OF RECORD. TAKE PRECAUTIONARY MEASURES TO PROTECT THE UTILITY LINES NOT OF RECORD OR NOT SHOWN. BE RESPONSIBLE FOR ANY AND ALL DAMAGE WHICH MAY OCCUR DUE TO FAILURE TO LOCATE AND PROTECT ALL CONCEALED UTILITIES.
12. COMPLY WITH ALL JURISDICTIONAL AGENCY REQUIREMENTS AND REGULATIONS. PERFORM ALL WORK ON THIS PROJECT IN COMPLIANCE WITH OCCUPATIONAL SAFETY AND HEALTH STANDARDS 29 CFR 1910 AND 1926 OF THE U.S. DEPARTMENT OF LABOR AND THE AMERICANS WITH DISABILITIES ACT ACCESSIBILITY GUIDELINES.
13. FINAL CONNECTIONS TO EQUIPMENT SHALL BE AS PER MANUFACTURER'S WIRING DIAGRAMS, DETAILS AND INSTRUCTIONS. BE RESPONSIBLE TO PROVIDE MATERIALS AND EQUIPMENT COMPATIBLE WITH EQUIPMENT ACTUALLY SUPPLIED.
14. PROVIDE PERMITS AND INSPECTIONS REQUIRED BY JURISDICTIONAL AGENCIES.
15. PROVIDE SET OF RECORD DRAWINGS TO ARCHITECT. DRAWINGS SHALL INCLUDE ALL ADDENDUM ITEMS, CHANGE ORDERS, ALTERATIONS, REROUTINGS, ETC.
16. SERVICE SHALL BE MAINTAINED TO EXISTING AREAS DURING CONSTRUCTION. PROVIDE PORTABLE GENERATORS, CABLES, OUTLETS ETC., TO MAINTAIN CONTINUITY OF SERVICE PLACEMENT OF SUCH PORTABLE EQUIPMENT SHALL BE SUBJECT TO OWNER APPROVAL.
17. COORDINATE CONSTRUCTION PHASING WITH THE OWNER. TEMPORARY PARTITIONS, LOCATIONS & CONSTRUCTION DETAILS IN PUBLIC SPACES SHALL BE SUBMITTED TO THE OWNER FOR APPROVAL PRIOR TO START OF CONSTRUCTION.
18. PATCH AND MATCH ALL NEW WORK W/ EXISTING WHERE NEW TO EXISTING INTERFACE OCCURS.
19. RESTORE ALL REMOVED OR DAMAGED STRUCTURAL STEEL CEMENTITIOUS FIRE PROOFING TO REQUIRED FIRE RESISTIVE STANDARD.
20. SUBMIT SAMPLES OF ALL EXPOSED PRODUCTS, MATERIALS, PAINTING SYSTEMS, ETC. FOR ARCHITECT'S REVIEW, COLOR SELECTION OR COLOR VERIFICATION PRIOR TO ORDERING ITEMS.
21. SEAL ALL DUCTS, LOUVERS, VENTS, OPENINGS AND CEILING SPACES BETWEEN CONSTRUCTION AREA AND REMAINDER OF SHELLED SPACES TO PREVENT DUST, DIRT, CONTAMINATION OR DEBRIS FROM ENTERING.
22. DO NOT ALLOW DIRT, DEBRIS OR DISCARDED MATERIALS TO ACCUMULATE ON SITE. REMOVE PROMPTLY EACH DAY.
23. VERIFY SERVICES TO BE ABANDONED, REMOVED OR CUT HAVE BEEN PROPERLY AND SAFELY SHUT OFF, CAPPED OR SEALED.
24. KEEP NOISE AND VIBRATION PRODUCING ACTIVITIES AT A MINIMUM WHEN WORKING WITHIN OR ON THE EXISTING BUILDING. APPROPRIATE TIMES OF SUCH ACTIVITIES SHALL BE COORDINATED WITH OWNER IN WRITING AT BEGINNING OF PROJECT.
25. IN THE EVENT THAT NOISE AND VIBRATION PRODUCING ACTIVITIES WILL OCCUR DURING TIMES OTHER THAN THOSE NOTED ABOVE, OBTAIN PERMISSION FROM THE OWNER IN WRITING A MINIMUM OF 72 HOURS PRIOR TO COMMENCEMENT OF ACTIVITIES.
26. KEEP UTILITY AND SERVICE OUTAGES TO A MINIMUM. MAKE WRITTEN OUTAGE REQUESTS AT LEAST FIVE DAYS BEFORE DATE OF PROPOSED OUTAGE. STATE IN THE REQUEST HOURS OF OUTAGE. CONFIRM DATE 48 HOURS IN ADVANCE OF STARTING DATE.
27. ASSIGN THE WORK OF MOVING, REMOVAL, CUTTING, PATCHING AND REPAIR TO TRADES UNDER CONTRACTOR SUPERVISION TO CAUSE THE LEAST DAMAGE TO EACH TYPE OF WORK ENCOUNTERED.
28. PATCHING OF FINISH MATERIALS TO MECHANICS SKILLED IN THE WORK OF THE FINISH TRADE INVOLVED.
29. PROTECT REMAINING FINISHES, EQUIPMENT AND ADJACENT WORK FROM DAMAGE CAUSED BY CUTTING, MOVING AND REMOVAL AND PATCHING OPERATIONS. PROTECT SURFACES WHICH WILL REMAIN A PART OF THE FINISHED WORK.
30. PROTECT EXISTING AND NEW WORK FROM WEATHER DURING CUTTING, MOVING, REMOVAL CONSTR. PROVIDE WEATHER PROTECTION AND OTHER FACILITIES AND PROTECTION AS NEEDED TO PREVENT DAMAGE TO NEW WORK AND TO REMAINING OLD WORK.
31. PROVIDE ADEQUATE SUPPORT OR SUBSTRATE FOR PATCHING FINISHES.
32. USE OF HAZARDOUS MATERIALS SHALL CONFORM WITH 29 CFR 1910.120 AND 1926.65 OF THE OSHA CODE.
33. REMOVAL OF HAZARDOUS WASTE SHALL COMPLY WITH CURRENT FEDERAL, STATE AND LOCAL REGULATIONS, STANDARDS, LAWS AND REQUIREMENTS.
34. THE WET SIDE FIRE PROTECTION CONTRACTOR SHALL PROVIDE TO THE ARCHITECT, THROUGH THE NORMAL SUBMITTAL PROCESS, SPRINKLER PLANS SHOWING PIPING PLANS, POINTS OF CONNECTIONS, HEAD LOCATIONS, VALVE LOCATIONS, CALCULATIONS, AND HEAD TYPES AND FINISHES PRIOR TO SUBMISSION TO THE FIRE DEPARTMENT FOR THE ARCHITECT'S REVIEW AND APPROVAL. DO NOT SUBMIT DRAWINGS TO ANY JURISDICTION PRIOR TO GAINING THIS REVIEW AND APPROVAL.
35. THE ELECTRONIC FIRE PROTECTION CONTRACTOR SHALL PROVIDE TO THE ARCHITECT, THROUGH NORMAL SUBMITTAL PROCESS, PLANS SHOWING THE SIZE, LOCATION, MOUNTING HEIGHTS, AND FINISH OF ALL STROBES, SPEAKERS, AND SPEAKER STROBES AS WELL AS SHOWING ALL CONDUIT RUNS, CONDUIT SIZES, AND POINTS OF CONNECTION FOR ARCHITECT'S REVIEW AND APPROVAL. DO NOT SUBMIT DRAWINGS TO ANY JURISDICTION PRIOR TO GAINING THIS REVIEW AND APPROVAL.



BUILDING KEYNOTE

3/4" = 1'-0"

SEH

Building a Better World for All of Us®

STATE OF COLORADO
ROBERT LEWIS EKSTROM
400982
LICENSED ARCHITECT

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Boulder County
Building Services Division
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Boulder County Building Services Division

JUSTICE CENTER DA INFILL

1777 6th St.
Boulder, CO 80302

SEH Project	135948
Project Manager	RE
Drawn By	CSN/MTM
Project Status	Issue Date
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date

GENERAL INFORMATION / ABBREVIATIONS AND LEGENDS

A
000

ROOM OCCUPANCY						
ROOM NAME	ROOM NUMBER	AREA	OCCUPANCY	O.L. FACTOR	OCC. LOAD	Level
OPEN OFFICE	100	5428	B	100	54.28	LEVEL 1
FAC/MAINT	101	286	B	100	2.86	LEVEL 1
ATTORNEY	102	129	B	100	1.29	LEVEL 1
ATTORNEY	103	129	B	100	1.29	LEVEL 1
ATTORNEY	104	129	B	100	1.29	LEVEL 1
ATTORNEY	105	129	B	100	1.29	LEVEL 1
ATTORNEY	106	129	B	100	1.29	LEVEL 1
ATTORNEY	107	128	B	100	1.28	LEVEL 1
VESTIBULE	108	129	B	100	1.29	LEVEL 1
ATTORNEY	109	129	B	100	1.29	LEVEL 1
ATTORNEY	110	130	B	100	1.30	LEVEL 1
ATTORNEY	111	130	B	100	1.30	LEVEL 1
ATTORNEY	112	128	B	100	1.28	LEVEL 1
ATTORNEY	113	132	B	100	1.32	LEVEL 1
ATTORNEY	114	129	B	100	1.29	LEVEL 1
ATTORNEY	115	131	B	100	1.31	LEVEL 1
STORAGE	116	30	B	100	0.30	LEVEL 1
STAIR #2	117	62	B	100	0.62	LEVEL 1
CONFERENCE	118	421	B	100	4.21	LEVEL 1
SUPPORT	120	115	B	100	1.15	LEVEL 1
STOR	121	26	B	100	0.26	LEVEL 1
LACTATION	122	114	B	100	1.14	LEVEL 1
EVIDENCE	123	39	B	100	0.39	LEVEL 1
DATA ROOM	125	197	B	100	1.97	LEVEL 1
ELEC.	126	162	B	100	1.62	LEVEL 1
SUPPORT	127	109	B	100	1.09	LEVEL 1
WOMEN'S	128	150	B	100	1.50	LEVEL 1
MEN'S	129	151	B	100	1.51	LEVEL 1
ELEV. MACHINE	130	110	B	100	1.10	LEVEL 1
BREAKROOM	131	199	B	100	1.99	LEVEL 1
COP LOUNGE	132	136	B	100	1.36	LEVEL 1
CONFERENCE	133	129	B	100	1.29	LEVEL 1
CONFERENCE	134	133	B	100	1.33	LEVEL 1
CONFERENCE	135	120	B	100	1.20	LEVEL 1
CONFERENCE	136	121	B	100	1.21	LEVEL 1
STAIR #1	137	313	B	100	3.13	LEVEL 1
ELEVATOR	138	96	B	100	0.96	LEVEL 1
		10453			104.53	
OPEN OFFICE	200	3658	B	100	36.58	LEVEL 2

ROOM OCCUPANCY						
ROOM NAME	ROOM NUMBER	AREA	OCCUPANCY	O.L. FACTOR	OCC. LOAD	Level
DA CONFERENCE	201	206	B	100	2.06	LEVEL 2
DA	202	153	B	100	1.53	LEVEL 2
ATTORNEY	203	132	B	100	1.32	LEVEL 2
ATTORNEY	204	132	B	100	1.32	LEVEL 2
ATTORNEY	205	132	B	100	1.32	LEVEL 2
ATTORNEY	206	131	B	100	1.31	LEVEL 2
CONFERENCE	207	282	B	100	2.82	LEVEL 2
ATTORNEY	208	131	B	100	1.31	LEVEL 2
ATTORNEY	209	132	B	100	1.32	LEVEL 2
ATTORNEY	210	132	B	100	1.32	LEVEL 2
ATTORNEY	211	132	B	100	1.32	LEVEL 2
ASSISTANT DA	212	132	B	100	1.32	LEVEL 2
ASSISTANT DA CONFERENCE	213	189	B	100	1.89	LEVEL 2
CONFERENCE	214	405	B	100	4.05	LEVEL 2
WOMEN'S	215	152	B	100	1.52	LEVEL 2
MEN'S	216	154	B	100	1.54	LEVEL 2
JANITOR	217	83	B	100	0.83	LEVEL 2
ELEVATOR	218	96	B	100	0.96	LEVEL 2
BREAKROOM	219	213	B	100	2.13	LEVEL 2
ATTORNEY	221	129	B	100	1.29	LEVEL 2
ATTORNEY	222	125	B	100	1.25	LEVEL 2
ATTORNEY	223	129	B	100	1.29	LEVEL 2
ATTORNEY	224	116	B	100	1.16	LEVEL 2
ATTORNEY	225	118	B	100	1.18	LEVEL 2
STAIR #1	226	310	B	100	3.10	LEVEL 2
SUPPORT	227	102	B	100	1.02	LEVEL 2
SUPPORT	228	102	B	100	1.02	LEVEL 2
SUPPORT	229	102	B	100	1.02	LEVEL 2
SUPPORT	230	102	B	100	1.02	LEVEL 2
		8114			81.14	
Grand total: 67		18568			185.68	

CODE LEGEND

- GROUP B
- EGRESS PATH
- EXIT ACCESS
- 1 HOUR SEPARATION
- 2 HOUR SEPARATION
- FE — SEMI-RECESSED FIRE EXTINGUISHER CABINET
- AREA OF REFUGE

CODE SUMMARY

GOVERNING CODE:
2012 INTERNATIONAL BUILDING CODE (IBC)
2017 CITY OF BOULDER ENERGY CONSERVATION CODE (COBECC)
2012 INTERNATIONAL FIRE CODE (IFC)
2012 INTERNATIONAL MECHANICAL CODE (IMC)
2012 INTERNATIONAL PLUMBING CODE (IPC)
2012 INTERNATIONAL FUEL GAS CODE (IFGC)
2017 NATIONAL ELECTRICAL CODE (NEC)
CITY OF BOULDER AMENDMENTS
2010 ADA STANDARDS FOR ACCESSIBLE DESIGN

BUILDING DATA:
2-STORY BUILDING
SEE OCCUPANCY TABLE THIS SHEET
SPRINKLED: YES
FIRE ALARM: YES
CONSTRUCTION TYPE IIB

(CHAPTER 3) USE & OCCUPANCY CLASSIFICATIONS:
GROUP B BUSINESS
OFFICES, RESTROOMS, CONFERENCE ROOMS, BREAK ROOMS

(TABLE 503): ALLOWABLE HEIGHT & AREA
TYPE II-B CONSTRUCTION
SPRINKLED
GROUP B
HEIGHT: 55' MAX FOR B OCCUPANCIES
ACTUAL: 35' ROOF PEAK/PARAPET
3 STORIES ALLOWED
ACTUAL: 2 STORIES
ALLOWABLE AREA: 23,000 MAX
ACTUAL: *19, 147 SF (NEW CONSTRUCTION SEPARATED BY FIRE WALLS TO BE CONSIDERED AS SEPARATE BUILDING)*

(TABLE 601): FIRE RESISTANCE RATINGS FOR BUILDING ELEMENTS
TYPE II-B:
EXTERIOR BEARING WALLS: 0 HOURS
ALL OTHER ELEMENTS: 0 HOURS

(707.3.10) FIRE AREAS
TABLE 707.3.10: OCCUPANT GROUP B: 2 HR

(713.4) SHAFT ENCLOSURES
FIRE RESISTANCE RATING: 1 HRS

(1004.1.2) OCCUPANT LOADS
GROUP B BUSINESS AT 100 GROSS
AREA: *18,516 SF*

FIRST FLOOR:
AREA: 10,399 SF
OCCUPANT LOAD: 104
SECOND FLOOR
AREA: 8,117 SF
OCCUPANT LOAD: 82

TOTAL OCCUPANT LOAD: 186

(1005) MEANS OF EGRESS SIZING
FIRST FLOOR
OCCUPANT LOAD: 104
REQ.D STAIRWAY WIDTH: 21"
OTHER EGRESS COMPONENTS: 16"

SECOND FLOOR
OCCUPANT LOAD: 82
REQ.D STAIRWAY WIDTH: 17"
OTHER EGRESS COMPONENTS: 13"

(1009) STAIRWAYS
1009.3 EXCEPTION 1: ENCLOSED STAIRWAY IS NOT REQUIRED FOR TWO STORIES

(1014.3) COMMON PATH OF EGRESS:
GROUP B: 100'-0" WITH SPRINKLER
ACTUAL: 25'-0"

(1016.2) EXIT ACCESS TRAVEL DISTANCE (DISTANCE TO STAIR ENCLOSURE OR EXTERIOR DOOR):
GROUP B: 300' WITH SPRINKLERS
ACTUAL MAX TRAVEL DISTANCE FIRST FLOOR: 152'
ACTUAL MAX TRAVEL DISTANCE SECOND FLOOR: 143'

(1022.2) INTERIOR EXIT STAIRWAYS: CONSTRUCTION
FIRE RATING OF INTERIOR EXIT STAIRWAY: 1 HOUR WHERE CONNECTING LESS THAN FOUR STORIES

FIXTURE COUNT:
TOTAL OCCUPANT LOAD: 186
MALE: 186/2= 93
FEMALE: 186/2= 93

WATER CLOSETS:
MALE: 1 PER 25; FIRST 50 = 2
(93-50)/50= 43/50 = 0.86 = 1
TOTAL: 3
FEMALE: 1 PER 25; FIRST 50 = 2
(93.5-50)/50= 43/50 = 0.86 = 1
TOTAL: 3

LAVATORIES:
MALE: 1 PER 40; FIRST 80= 2
= (93-80)/80 = 0.163 = 1
TOTAL: 3
FEMALE: 1 PER 40; FIRST 80= 2
= (93-80)/80 = 0.163 = 1
TOTAL: 3

DRINKING FOUNTAIN:
186/100 = 1.86 = 2

SERVICE SINK: 1 REQUIRED

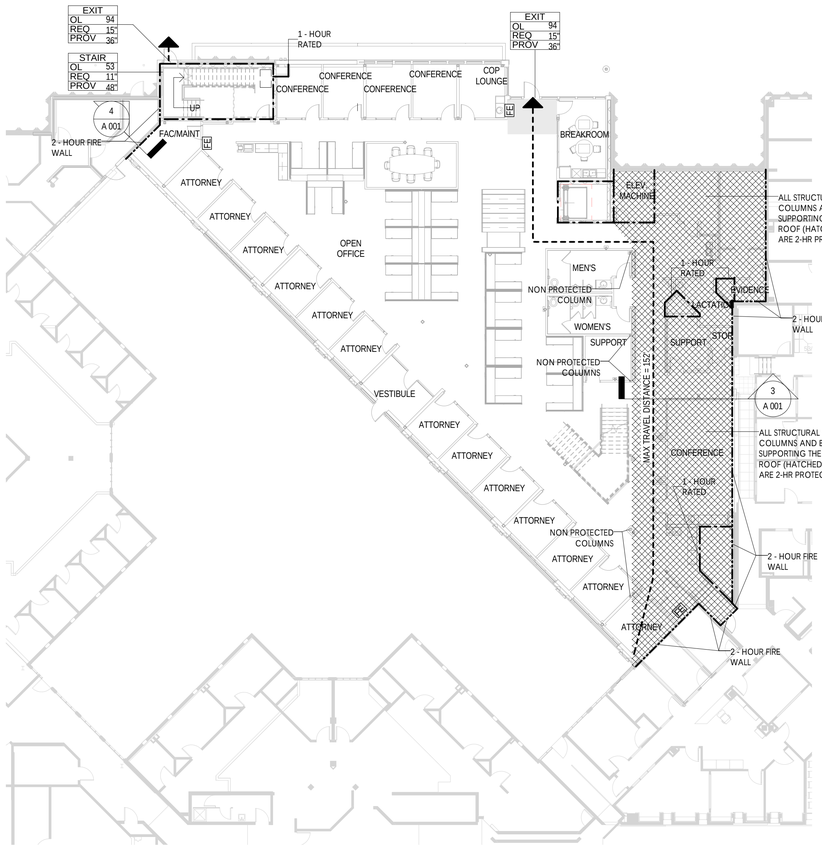
(706) FIRE WALL

706.1 GENERAL: TO CREATE SEPARATE BUILDINGS TO SEPARATE ALLOWABLE AREAS.
706.1.1 PARTY WALLS: NOT APPLICABLE
706.2: STRUCTURAL STABILITY: STRUCTURAL STABILITY TO NOT COLLAPSE FOR THE DURATION OF 2-HR (FROM TABLE 706.4)
706.3: MATERIALS: MATERIALS ARE NON-COMBUSTIBLE (CONCRETE AND CMU)
706.4: FIRE RESISTANCE RATING: OCCUPANCIES ARE A, B AND I. PER TABLE 706.4 (EXCEPTION A) FOR TYPE II – 2-HR
706.5: HORIZONTAL CONTINUITY:
- EXCEPTION 1: ALL EXTERIOR WALLS AT FIRE WALL LOCATIONS ARE OF CMU WITH RATING OF AT LEAST 1-HR. ANY OPENING WITHIN 4' IS 45 MINUTE RATED.
- EXCEPTION 3: BOTH SIDES OF THE FIRE WALL ARE PROTECTED WITH AUTOMATIC SPRINKLER SYSTEM.

706.5.1: EXTERIOR WALL: OPTION 1: WITH MINIMUM OF 1-HR RATED WALL (CMU), ANY OPENINGS WITHIN 4' IS 45 MIN RATED.
706.5.2: HORIZONTAL PROJECTED ELEMENTS: NOT APPLICABLE – NO HORIZONTAL PROJECTED ELEMENT.
706.6: VERTICAL CONTINUITY:
- EXCEPTION 1: STEPPED BUILDING: FOLLOW 706.6.1 SEE BELOW

706.6.1: STEPPED BUILDING: THE CMU FIRE WALL CONTINUES TO THE ROOF LEVEL OF THE HIGHER ROOF. NO OPENING IS PROPOSED ON THE FIRE WALL ABOVE THE LOW ROOF.
706.6.2 BUILDING WITH SLOPED ROOF: NOT APPLICABLE – BUILDING DOES NOT HAVE SLOPED ROOF.
706.7: COMBUSTIBLE FRAMING IN FIRE WALLS: NOT APPLICABLE – NO COMBUSTIBLE FRAMING IS PROPOSED.
706.8: OPENINGS: AGGREGATE WIDTH IS LESS THAN 25% OF LENGTH OF WALL. (6' OF 133' – 4.5% & 3' OF 18' – 17%)
- EXCEPTION 2: BOTH BUILDINGS ARE SPRINKLERED. NO SIZE LIMITATION.

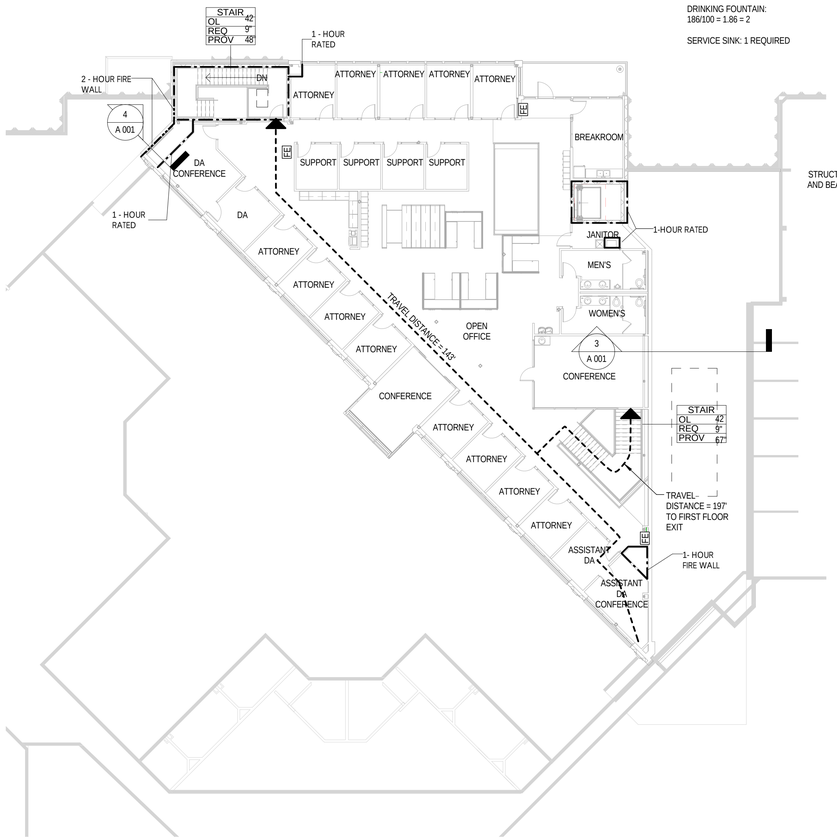
706.9: PENETRATIONS: PENETRATIONS ARE PROTECTED PER SECTION 714.
706.10: JOINTS: NOT APPLICABLE - NO JOINT
706.11: DUCTS AND AIR TRANSFER OPENING: ALL DUCTS AND AIR TRANSFER OPENINGS ARE PROTECTED PER 717.



1 CODE PLAN - LEVEL 1
1/16" = 1'-0"

TRUE NORTH

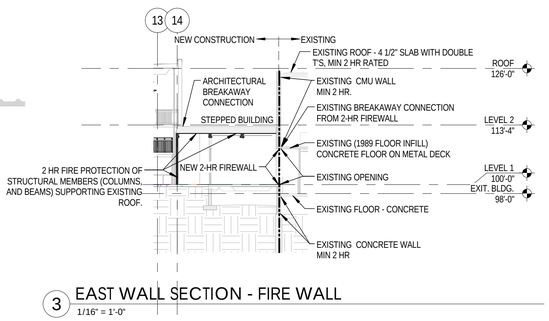
PLAN NORTH



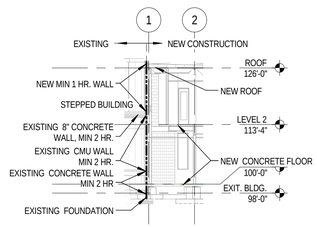
2 CODE PLAN - LEVEL 2
1/16" = 1'-0"

TRUE NORTH

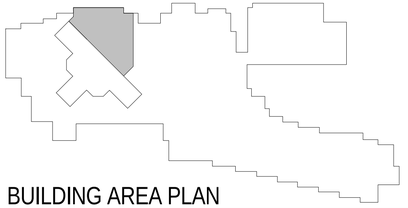
PLAN NORTH



3 EAST WALL SECTION - FIRE WALL
1/16" = 1'-0"



4 WEST WALL SECTION - FIRE WALL
1/16" = 1'-0"



BUILDING AREA PLAN
NOT TO SCALE

SEH
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Owner
Boulder County
Building Services Division
2020 13th Street
Boulder, Colorado 80302
303.441.3925

Architect / Landscape
Short Elliott Hendrickson, Inc.
2000 South Colorado Boulevard
Tower One, Suite 6000
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5420 Ward Rd.
Arvada, Colorado 80002
303.422.7400

Boulder County Building Services Division

JUSTICE CENTER DA INFILL

1777 6th St.
Boulder, CO 80302

SEH Project	135948
Project Manager	RE
Drawn By	CS/NM/TM
Project Status	Issue Date
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date
1	ADDENDUM 1	12/01/2017
2	ADDENDUM 2	01/16/2018
3	PERMIT COMMENTS	06/01/2018

CODE INFORMATION

A 001

Commercial
Mandatory Measures Checklist

2017
City of Boulder
Energy Conservation Code

Applies to: All New Buildings, Additions, Alterations and Repairs which require a permit from the City.

Project Address: 1777 6TH STREET, BOULDER, CO 80302 Date: 1/25/2018

DIRECTIONS: Compliance with these Mandatory Measures is required whether the project is demonstrating compliance through the Performance or Prescriptive Path. Please complete this checklist and include it on an "Energy Conservation Code" sheet within the plans being submitted for permit application.

Code Section	Focus Area	Code Description	Plan Drawing or Reference # to demonstrate compliance (N/A if not applicable)	Submitter Notes (e.g. If "N/A" Please explain why requirement does not apply or is not demonstrated on plans/specs)	Plans Examiner Notes (in office use)
C401.2	Check compliance path applicable	New Construction < $500,000	☐	Construction Value:	
		New Construction >/= $500,000	☐	$5,500,000	
		Alteration: Construction Value < 26% Actual Value*	☑	Construction Value/Actual Value:	
		Alteration: Construction Value 26-50% Actual Value*	☐	$5,500,000/$42,835,000	
		Alteration: Construction Value >50% Actual Value*	☐	= 12.8%	-
		*Actual Value of the existing structure can be found in Boulder Count Tax Assessor's database: http://maps.bcgis.solutions/propertysearch/			
BUILDING ENVELOPE					
C402.1.3	Fenestration and Doors	Procedures for determining fenestration and door performance are described in C402.1.3. Product Samples used for determining fenestration performance shall be production line units or representative of units purchased by the consumer or contractor.	Specification 014000 - Quality Requirements		☐ Field Verify
C402.4.1	Air Barriers	The entire building envelope shall be designed and constructed with a continuous air barrier.	A011, A301, A311, A312, A313		☐ Field Verify
C402.4.1.1	Air Barrier Design/ Construction	The air barrier shall be designed and noted in an approved manner per the specified code.	A011, A301, A311, A312, A313		☐ Field Verify
C402.4.1.2	Continuous Air Barrier	Continuous air barrier is wrapped, sealed, caulked, gasketed, and/or taped in an approved manner per the specified code.	A501, A502, A503		☐ Field Verify
C402.4.1.2.1	Building Test	The completed building shall be tested and the air leakage rate of the building envelope shall not exceed 0.40 cfm/ft2 at a pressure differential of 0.3 inches water gauge (0.0Ls + ncl at 75 Pa) in accordance with ASTM E 779 or an equivalent method approved by the code official.	Specification 014000 - Quality Requirements		Documentation Required [ ] Air Leakage Test Results
C402.4.1.2.2	Dwelling Unit Air Infiltration	A sampling of dwelling units shall be tested and results shall not exceed 0.25cfm/ft2. See code for more details.	N/A	No dwelling units.	☐ Field Verify
C402.4.2	Penetrations	Penetrations of the air barrier and paths of air leakages shall be caulked, gasketed or otherwise sealed.	A501, A502, A601		☐ Field Verify
C402.4.3	Fenestration	Rain/snow/air fenestration and doors are labeled as weather air leakage	Specification 014000 -		

Code Section	Focus Area	Code Description	Plan Drawing or Reference # to demonstrate compliance (N/A if not applicable)	Submitter Notes (e.g. If "N/A" Please explain why requirement does not apply or is not demonstrated on plans/specs)	Plans Examiner Notes (in office use)
C402.4.6	Loading Dock Weather Seals	Cargo doors and loading dock doors are equipped with weather seals to restrict infiltration when vehicles are parked in the doorway.	N/A	N/A - No loading dock.	☐ Field Verify
C402.4.7	Vestibules	Vestibules are installed where building entrances separate conditioned space from the exterior, and meet exterior envelope requirements. Doors have self-closing devices, and are >=7 ft apart.	N/A	The project does not have any public entrance. The doors shown opening to the canyon blvd are just convenience and exit doors.	☐ Field Verify

Commercial (Envelope ONLY)
Prescriptive Measures Checklist

2017
City of Boulder
Energy Conservation Code

Applies to: New Buildings and Additions with a construction valuation of <$500,000; Alterations and Repairs are determined by construction valuations and should refer to Table C401.2.2.

Project Address: 1777 6th St. Boulder, CO 80302 Date: 1/25/2018

DIRECTIONS: Compliance with these measures is required if the project uses the Prescriptive Compliance Path. Please complete this checklist and include it on an "Energy Conservation Code" sheet within the plans being submitted for permit application. Projects complying prescriptively also must meet Mandatory Measures and should include the Mandatory Measures Checklist as well.

Code Section	Focus Area	Code Description		All Other	Group R (Mixed Use)	Plan Drawing or Reference # to demonstrate compliance (N/A if not applicable)	Submitter Notes (e.g. If "N/A" Please explain why requirement does not apply or is not demonstrated on plans/specs)	Plans Examiner Notes (in office use)
BUILDING ENVELOPE								
TABLE C402.1.3	Assembly	Roof	Insulation entirely above deck	Max U-0.030	Max U-0.030			
			Metal buildings	Max U-0.035	Max U-0.035			
			Attic and other	Max U-0.020	Max U-0.021			☐ Field Verify
		Walls, Above Grade	Mass	Max U-0.078	Max U-0.078			
			Metal building	Max U-0.048	Max U-0.052			
			Metal Framed	Max U-0.052	Max U-0.064			
			Wood Framed and other	Max U-0.048	Max U-0.064			☐ Field Verify
		Walls, Below Grade	Below-grade wall	Max C-0.119	Max C-0.119			☐ Field Verify
		Floors	Mass	Max U-0.054	Max U-0.064			
			Joist/Framing	Max U-0.033	Max U-0.033			
			Unheated slabs	Max F-0.484	Max F-0.54			
			Heated slabs	Max F-0.58	Max F-0.58			☐ Field Verify

Code Section	Focus Area	Code Description				Plan Drawing or Reference # to demonstrate compliance (N/A if not applicable)	Submitter Notes (e.g. If "N/A" Please explain why requirement does not apply or is not demonstrated on plans/specs)	Plans Examiner Notes (in office use)
TABLE C402.2	Insulation	Roof	Insulation entirely above deck	Min R-32.9 continuous	Min R-25 continuous	A011		
			Metal buildings (w/R-5 thermal blocks)	Min R-19 + R-11 linear system	Min R-19 + R-11 linear system			
			Attic and other	Min R-50.1	Min R-49			☐ Field Verify
		Walls, Above Grade	Mass	Min R-12.8 continuous	Min R-13.3 continuous	A011		
			Metal building	Min R-13 + R-13 continuous	Min R-13 + R-13 continuous			
			Metal framed	Min R-13 + R-8.1 continuous	Min R-13 + R-7.5 continuous			
			Wood framed and other	Min R-13 + R-6.1 continuous or R-20	Min R-13 + R-5.5 continuous or R-20 + R-3.8 continuous			☐ Field Verify
		Walls, Below Grade	Below-grade wall	Min R-8.8 continuous	Min R-7.5 continuous	N/A	Project has no below grade walls	
		Floors	Mass	Min R-18.5 continuous	Min R-12.5 continuous	N/A		
			Joist/Framing	Min R-31.9	Min R-30		Project only has slab on grade floors	☐ Field Verify
Table C402.2		Slab-on-Grade Floors	Unheated slabs	Min R-15 for 24" below	Min R-10 for 24" below	A011 & A501		
			Heated slabs	Min R-15 for 36" below	Min R-15 for 36" below			☐ Field Verify
		Opaque Doors	Swinging	Max U-0.37	Max U-0.37	SPEC SECTION: 088113		
			Roll-up or sliding	Min R-4.75	Min R-4.75			☐ Field Verify
C402.2.8		Radiant Heating	Radiant Panels, associated U-bends, and headers	Min R-3.5		N/A	No Radiant heating	☐ Field Verify
C402.3.1		Fenestration[1]	Area	Not to exceed 30% gross above-grade wall area		SPEC SECTION: 084113, 084100		
C402.3			Vertical fenestration U-factor	Fixed	Max U-0.38			
				Operable	Max U-0.45			
				Entrance doors >50% glass area	Max U-0.73			☐ Field Verify
			SHGC	Max 0.38				
		Skylights	U-factor	Max U-0.475		SPEC SECTION: 081671, 08 44 7/A502		
			SHGC	Max 0.38				
C402.3.1			Area	Not to exceed 3% gross floor area				
C402.2.1			Curb Insulation	Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.				☐ Field Verify

Code Section	Focus Area	Code Description		Plan Drawing or Reference # to demonstrate compliance (N/A if not applicable)	Submitter Notes (e.g. If "N/A" Please explain why requirement does not apply or is not demonstrated on plans/specs)	Plans Examiner Notes (in office use)
BUILDING ENVELOPE CONTINUED						
C402.3.2	Fenestration[1]	Minimum Skylight Fenestration	For enclosed spaces greater than 10,000 square feet, directly under a roof with ceiling heights greater than 15 feet, plan submitter must include supporting documentation showing the total daylight zone under skylights shall be not less than half the floor area and shall provide a minimum skylight area to daylight zone under skylights of either: 1. Not less than 3 percent with a skylight VT of at least 0.40; or 2. Provide a minimum skylight effective aperture of at least 1 percent or 3. Provide exception documentation.	N/A	Spaces are less than 10,000 SF, and ceiling heights are less than 15'	☐ Field Verify

1. Per C402.3.4, an area-weighted average shall be permitted to satisfy the U-factor requirements for each fenestration product category listed in Table C402.3. Individual fenestration products from different fenestration product categories listed in Table C402.3 shall not be combined in calculating area-weighted average U-factor.

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Boulder County Building Services Division

JUSTICE CENTER DA INFILL

1777 6th St.
Boulder, CO 80302

SEH Project	135948
Checked By	RE
Drawn By	NM, CS, RE

Project Status	Issue Date
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

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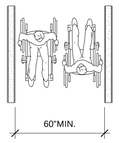
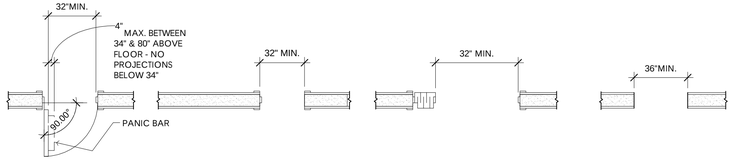
ENERGY CONSERVATION CODE

A
001A

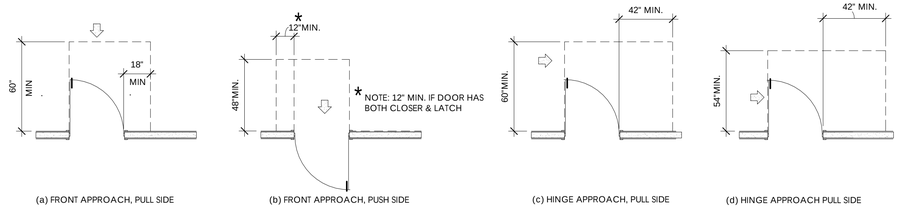


MINIMUM CLEAR WIDTH FOR TWO WHEELCHAIRS

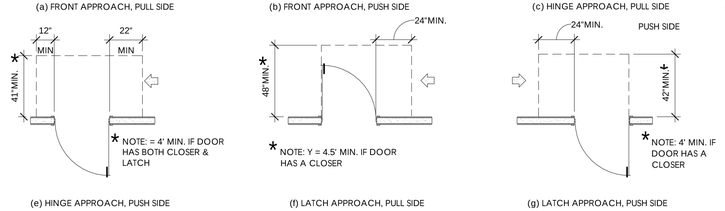


(a) HINGED DOOR (b) SLIDING DOOR (c) FOLDING DOOR (d) NO DOOR

CLEAR WIDTH OF DOORWAYS

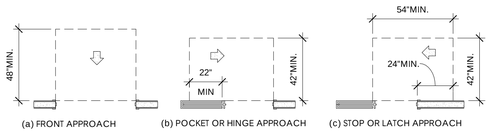


(a) FRONT APPROACH, PULL SIDE (b) FRONT APPROACH, PUSH SIDE (c) HINGE APPROACH, PULL SIDE (d) HINGE APPROACH PULL SIDE

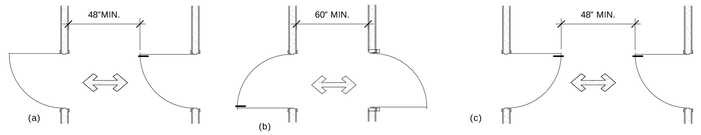


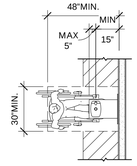
(e) HINGE APPROACH, PUSH SIDE (f) LATCH APPROACH, PULL SIDE (g) LATCH APPROACH, PUSH SIDE

MANEUVERING CLEARANCE AT SWINGING DOORS



(a) FRONT APPROACH (b) POCKET OR HINGE APPROACH (c) STOP OR LATCH APPROACH





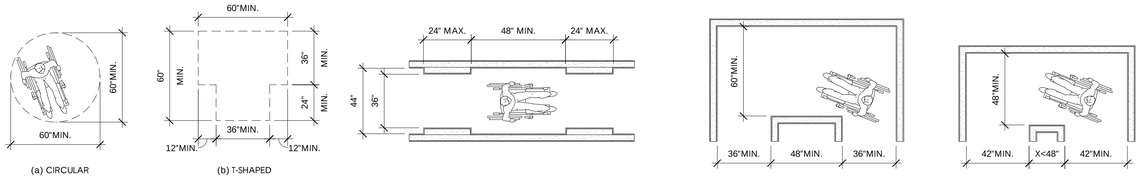
MANEUVERING CLEARANCE AT SLIDING AND SWINGING DOORS

TWO DOORS IN SERIES

CLEAR FLOOR SPACE DRINKING FOUNTAINS

4 MANEUVERING CLEARANCES

1/4" = 1'-0"



(a) CIRCULAR (b) T-SHAPED

SIZE OF WHEELCHAIR TURNING SPACE

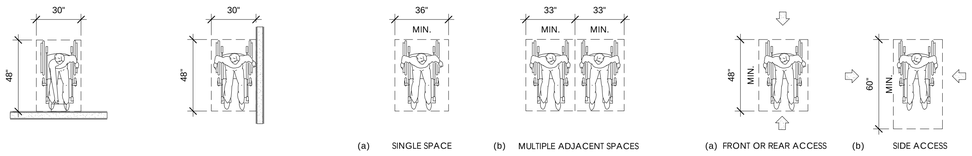
CLEAR WIDTH OF AN ACCESSIBLE ROUTE

ACCESSIBLE ROUTE FOR 180 DEGREE TURN

CLEAR WIDTH AT TURN

3 WHEEL CHAIR TURNING SPACE REQUIRMENTS

1/4" = 1'-0"



FORWARD APPROACH PARALLEL APPROACH

(a) SINGLE SPACE (b) MULTIPLE ADJACENT SPACES

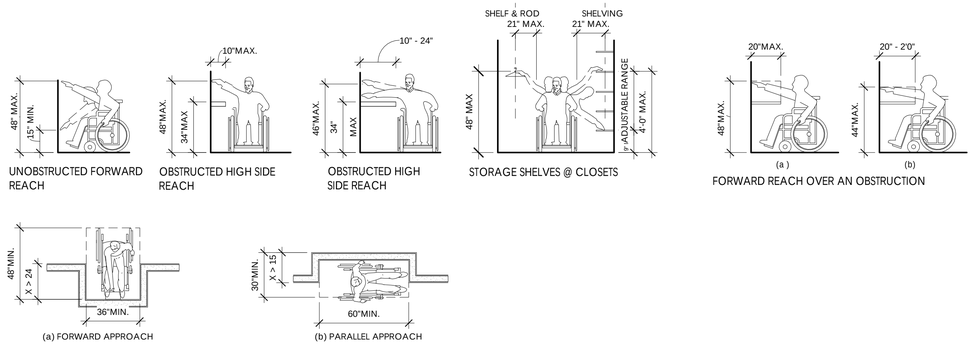
WIDTH OF A WHEEL CHAIR SPACE IN AUDITORIUM & ASSEMBLY AREAS

(a) FRONT OR REAR ACCESS (b) SIDE ACCESS

DEPTH OF A WHEEL CHAIR SPACE IN AUDITORIUM & ASSEMBLY AREAS

2 WHEEL CHAIR SPACE REQUIREMENTS

1/4" = 1'-0"



(a) UNOBSTRUCTED FORWARD REACH (b) OBSTRUCTED HIGH SIDE REACH (c) OBSTRUCTED HIGH SIDE REACH (d) STORAGE SHELVES @ CLOSETS

(a) (b) FORWARD REACH OVER AN OBSTRUCTION

(a) FORWARD APPROACH (b) PARALLEL APPROACH

1 ACCESSIBLE REACH REQUIRMENTS

1/4" = 1'-0"

GENERAL NOTES

1. THIS PROJECT IS DIVIDED INTO TWO PHASES: "CORE AND SHELL" AND "TENANT INTERIORS". REFER TO SECTION 011100 RESPONSIBILITY MATRIX IN THE PROJECT MANUAL FOR A DETAILED BREAKDOWN OF WORK IN EACH PHASE
2. ALL DIMENSIONS TO FACE OF STEEL STUD OR EXISTING FINISH UNLESS NOTED OTHERWISE.
3. PATCH WALLS AS REQUIRED WHERE ITEMS WERE PREVIOUSLY MOUNTED TO WALL.
4. A002 AND A003 FOR MOUNTING DIMENSIONS AND CLEARANCES
5. FIELD VERIFY ALL DIMENSIONS. NOTIFY ARCHITECT IF DIMENSIONS VARY SIGNIFICANTLY.

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Drawn By	NM, CS, RE

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ADA DETAILS

A
002

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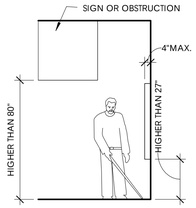
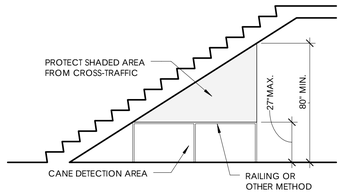
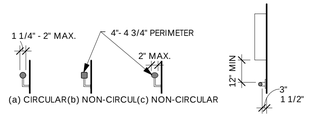


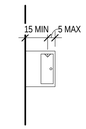
LIMITS OF PROTRUDING OBJECTS



REDUCED VERTICAL CLEARANCE



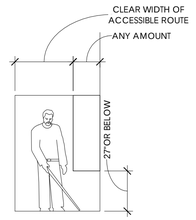
2 BATHROOM/TOILET COMPARTMENT GRAB BARS
1/4" = 1'-0"



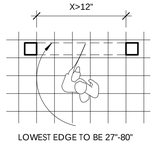
DRINKING FOUNTAIN SPOUT LOCATION

3 DRINKING FOUNTAIN
1/4" = 1'-0"

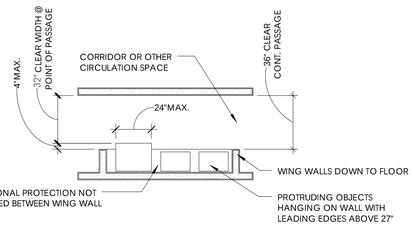
REFER TO 5/A003 FOR REQ'D KNEE AND TOE CLEARANCES



WALKING PARALLEL TO A WALL

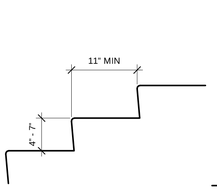


PROTRUDING OBJECTS

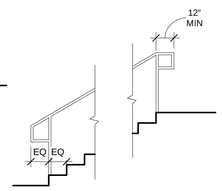


EXAMPLE OF PROTECTION AT WALL MOUNTED OBJECTS

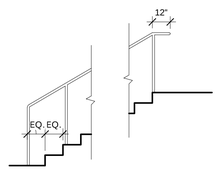
7 PROTRUDING OBJECTS
1/4" = 1'-0"



TREADS AND RISERS FOR ACCESSIBLE STAIRWAYS

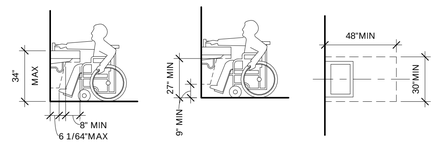


TOP AND BOTTOM EXTENSIONS AT STAIR - OPEN SIDES



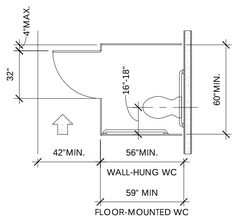
TOP AND BOTTOM EXTENSIONS AT STAIR - WALL SIDES

6 VERTICAL CIRCULATION
1/4" = 1'-0"

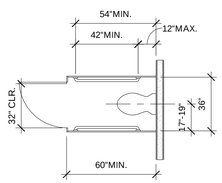


HEIGHT AND LOCATION OF LAVATORIES AND SINKS & & EXPOSED PIPE CLEARANCES

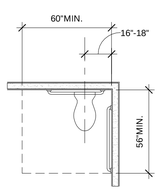
5 LAVATORIES AND SINKS
1/4" = 1'-0"



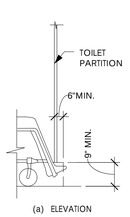
WHEELCHAIR ACCESSIBLE TOILET COMPARTMENT AND DOOR



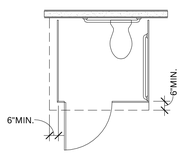
AMBULATORY ACCESSIBLE COMPARTMENT AND DOOR

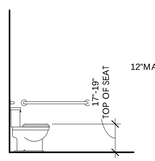


WATER CLOSET SIZE & SIZE OF CLEARANCE FOR WATER CLOSET

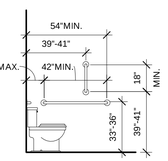


TOILET COMPARTMENT TOE CLEARANCE

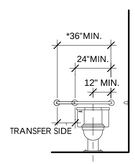




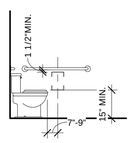
HEIGHT OF WATER CLOSET



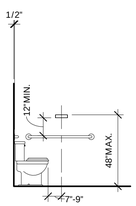
SIDE WALL GRAB BAR FOR WATER CLOSET

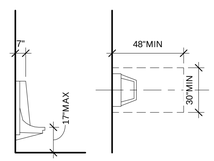


REAR WALL GRAB BAR FOR WATER CLOSET



DISPENSER LOCATION





URINAL

4 TOILET STALL CLEARANCES AND ACCESSORIES
1/4" = 1'-0"

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100 N. Wilcox Street
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Boulder County Building Services Division

JUSTICE CENTER DA INFILL

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SEH Project	135948
Checked By	RE
Drawn By	NM, CS, RE

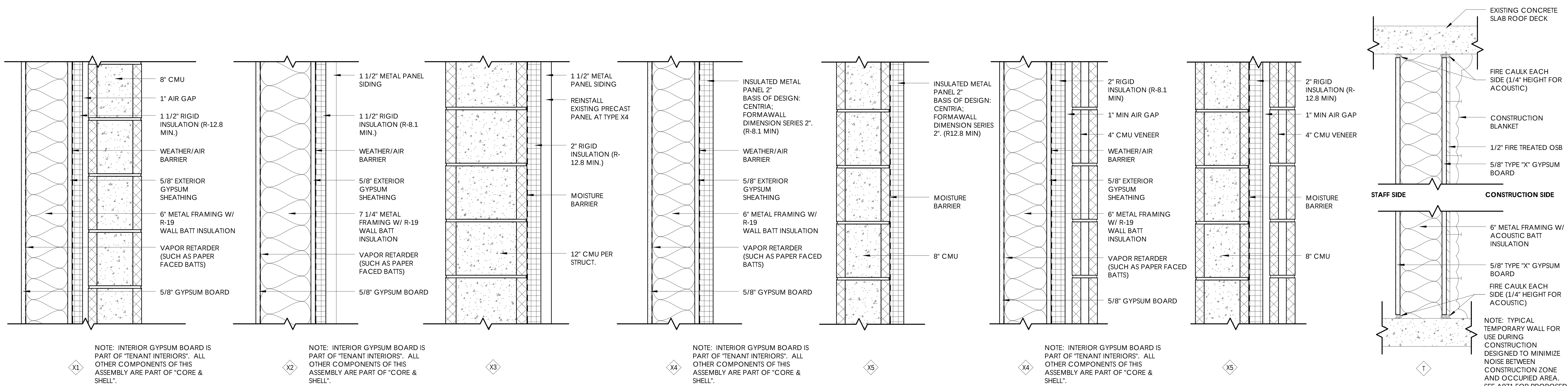
Project Status	Issue Date
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date

ADA DETAILS

A
003



EXTERIOR WALL ASSEMBLY TYPES

1 1/2" = 1'-0"

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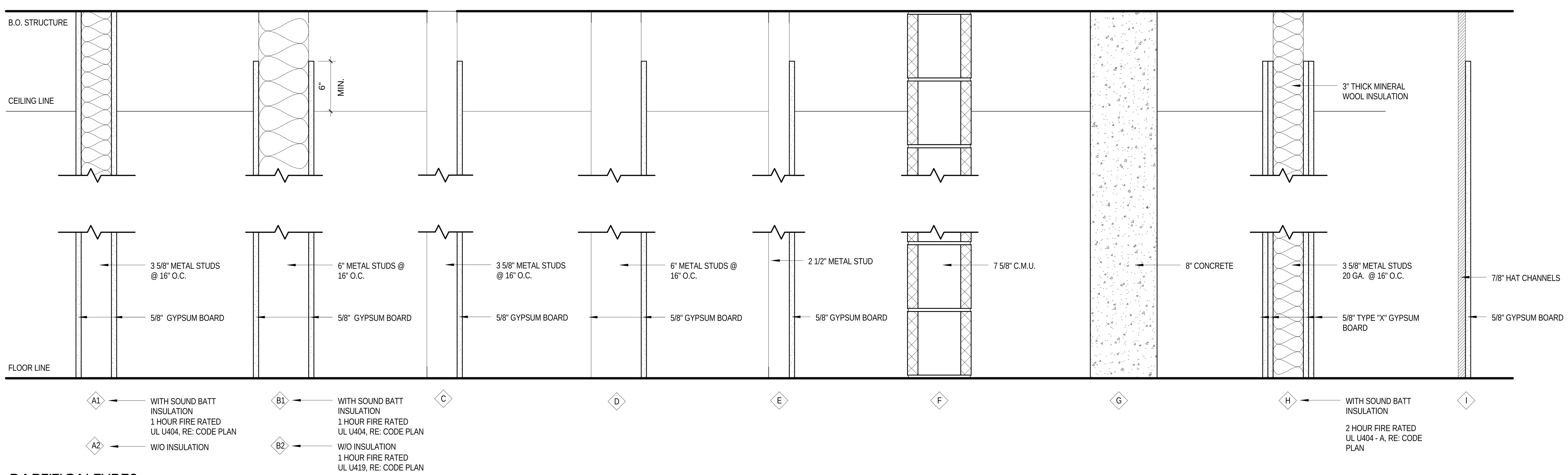
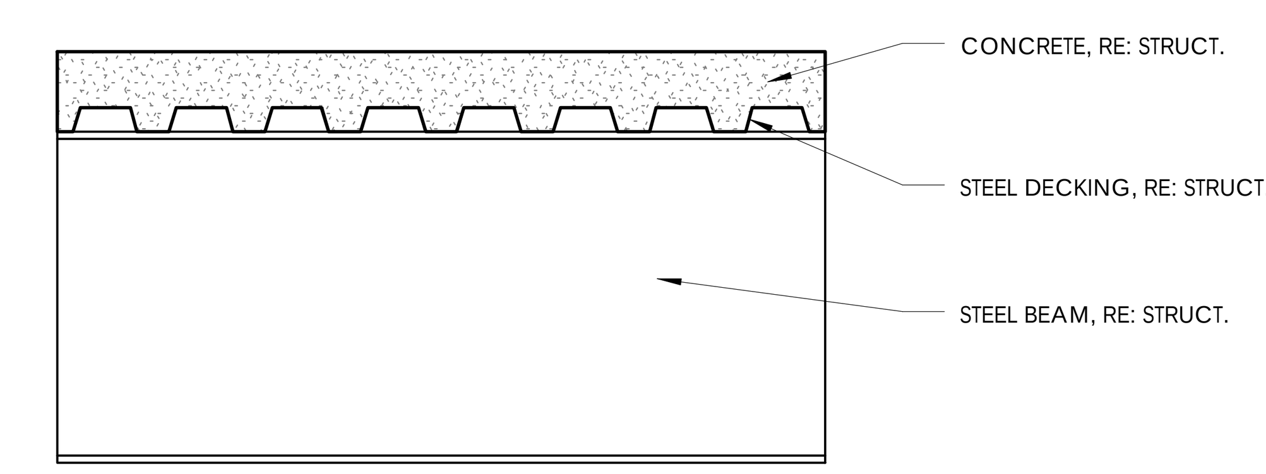
4. A002 AND A003 FOR MOUNTING DIMENSIONS AND CLEARANCES
5. FIELD VERIFY ALL DIMENSIONS. NOTIFY ARCHITECT IF DIMENSIONS VARY SIGNIFICANTLY.



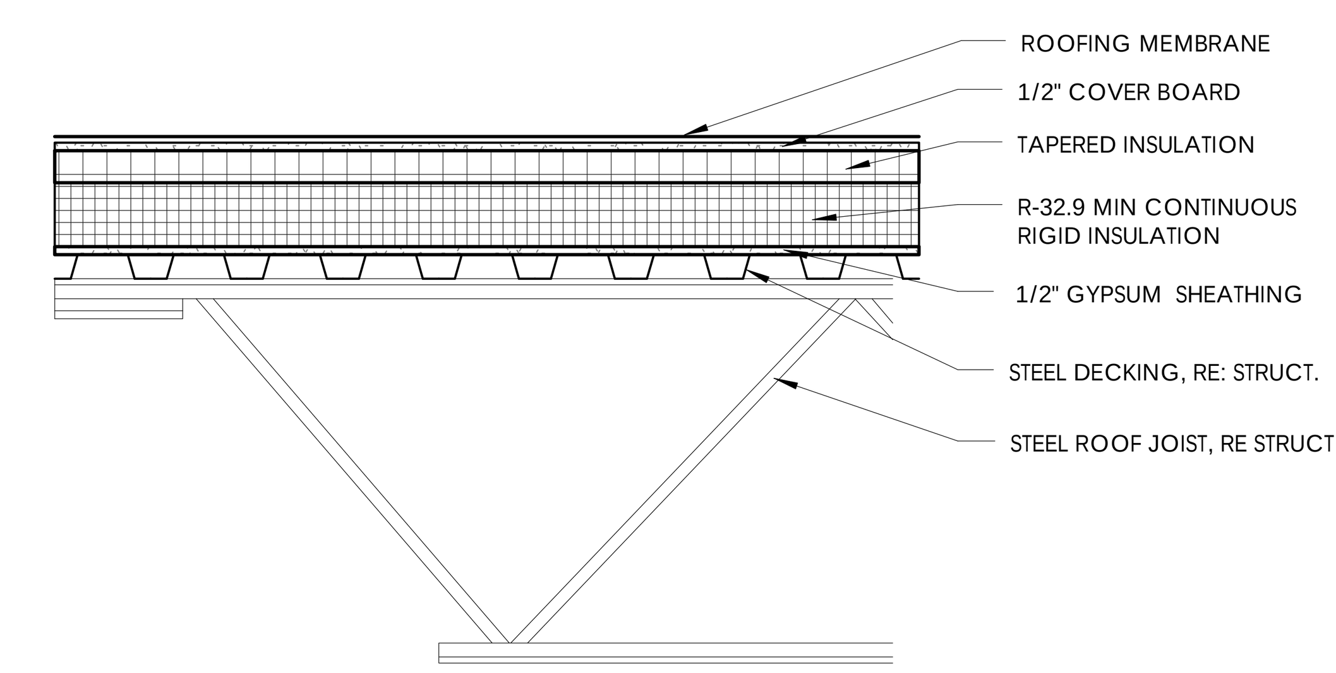
PARTITION TYPES

1 1/2" = 1'-0"



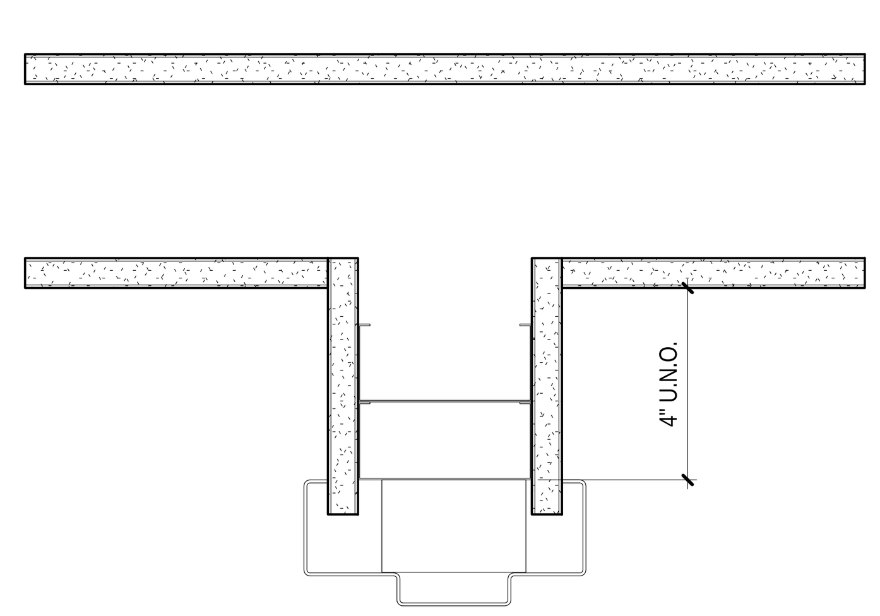
FLOOR ASSEMBLY

1" = 1'-0"



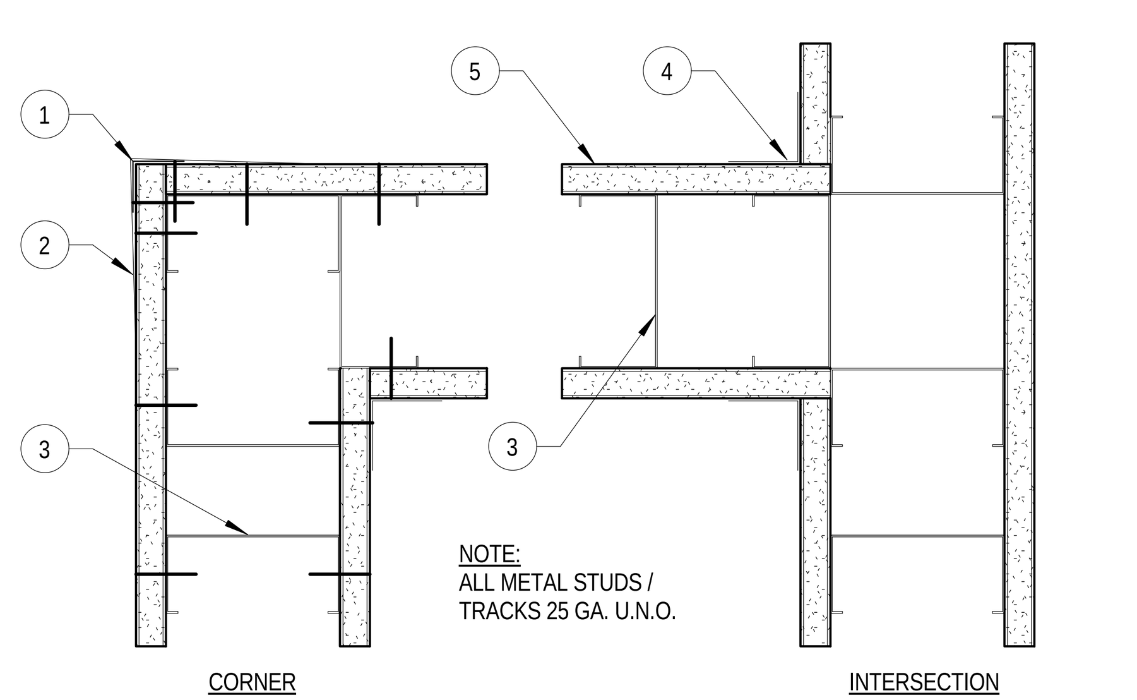
ROOF ASSEMBLY - R1

1" = 1'-0"



7 TYPICAL DOOR JAMB DETAIL

3" = 1'-0"

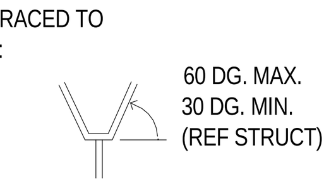


1. METAL CORNER BEAD - FORM TIGHT 90 DG. CORNER AND SCREW TO STUD
2. 3 COAT JOINT COMPOUND COVER BEAD AND FEATHER FOR SMOOTH FINISH
3. TYP. METAL STUD AND DRYWALL SCREWS
4. JOINT TAPE, TYP.
5. GWB AS NOTED

6 GWB PARTITION DETAILS

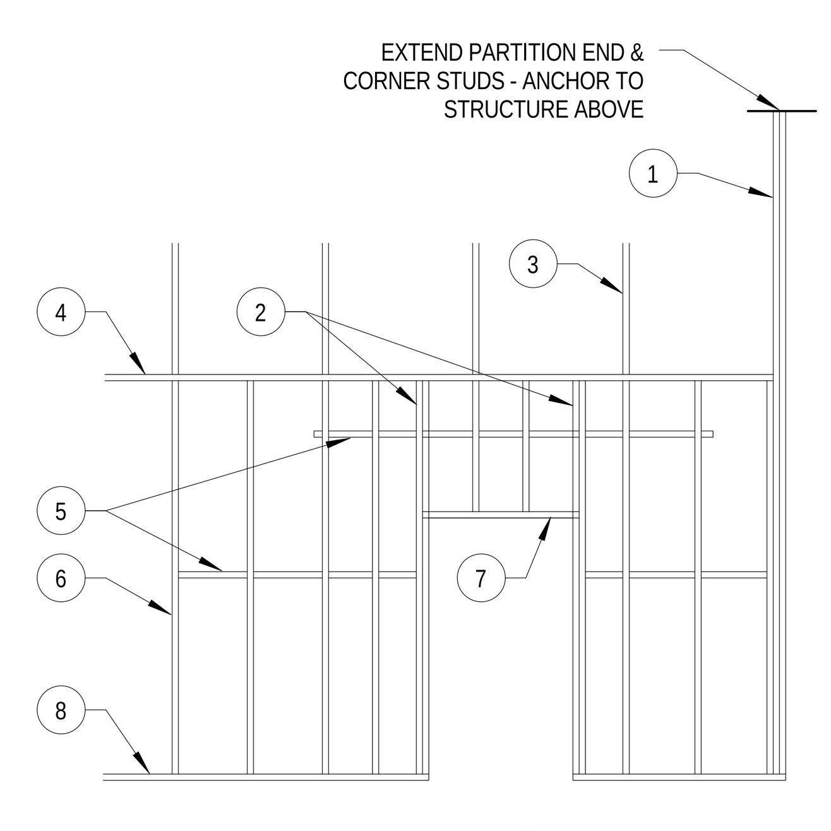
3" = 1'-0"

1. DOUBLE STUDS AT PARTITION ENDS, CORNERS, INTERSECTIONS AND OPENINGS
2. 20 GA. DOUBLE JAMB STUDS TYP. @ DOOR OPENINGS
3. STUDS AT 48" O.C. BRACED TO STRUCTURE ABOVE:
4. ALTERNATE STUDS - CUT, BEND & RIVET



5. 25 GA. CONT. CEILING TRACK MATCH STUD GA.
6. 3/4"x16 GA. C.R. STL. CHAN. @ 6'-0" AFF CONTINUOUS & 8'-0" AFF ABOVE OPENINGS - EXTEND & TIE MIN. 2 STUDS BEYOND OPENING STUDS AT 16" O.C. TYP.
6. STUDS AT 24" O.C. TYP.
7. 20 GA. RUNNER TRACK FASTENED TO JAMB STUDS
8. CONT. 25 GA. FLOOR TRACK EXCEPT TO MATCH STUD GAUGE

NOTE :
INSTALL 20 GA. DBL. STUDS AT WALL MOUNTED PLBG. & ELECT. FIXTURES, COUNTERS, TOILET PARTITIONS AND OTHER SIMILAR EQUIP. LOCATIONS.

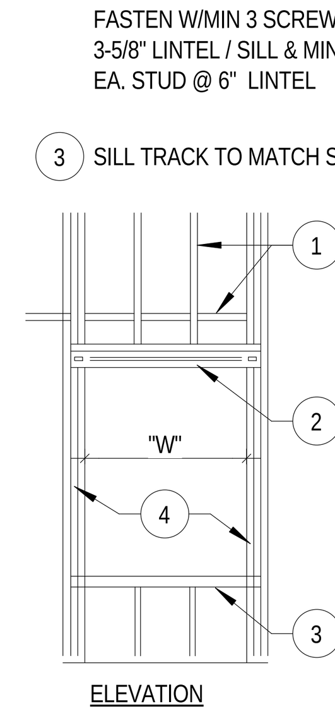


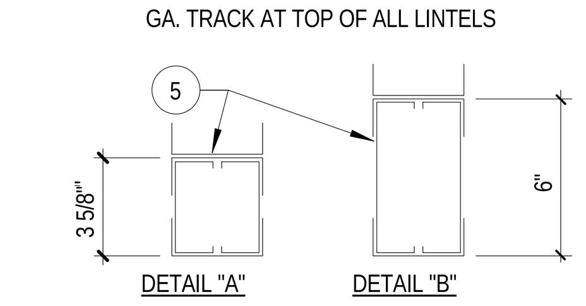
ALL METAL STUDS/TRACKS 25 GA. U.N.O.

5 METAL STUD FRAMING

1" = 1'-0"

1. STUD FRMG. PER WALL TYPES
2. LINTEL AS SCHEDULED - EXTEND VERT. TRACK WEBS OVER JAMB STUDS & FASTEN W/MIN 3 SCREWS EA. STUD @ 3-5/8" LINTEL / SILL & MIN. 5 SCREWS EA. STUD @ 6" LINTEL
3. SILL TRACK TO MATCH STUD GA.
4. 20 GA. JAMB STUDS
5. 2 HORIZ. TRACK SCREWED TO 2 20 GA. VERTICAL STUDS @ MAX. 6" O.C. BOTH STUDS BOTH SIDES PROVIDE CONT. 20 GA. TRACK AT TOP OF ALL LINTELS





LINTEL SCHEDULE

MARK WIDTH "W"	LINTEL	JAMB (EA. SIDE)
UP TO 3'-4"	SINGLE 20 GA. TRACK PER 1/A4.1	2 FULL HEIGHT STUDS
OVER 3'-4" TO 9'-0"	DETAIL "A" OR MFR.RECOMM.	2 FULL HEIGHT STUDS
OVER 9'-0" TO 13'-0"	DETAIL "B" OR MFR.RECOMM.	3 FULL HEIGHT STUDS
OVER 13'-0"	FRAME PER INDIVIDUAL DETAIL ON STRUCT. AND/OR ARCH DWGS.	

NON-BEARING PARTITIONS

4 OPENING IN PARTITION DETAIL

1" = 1'-0"

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1777 6th St.
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SEH Project	135948
Project Manager	RE
Drawn By	CS/NM/TM
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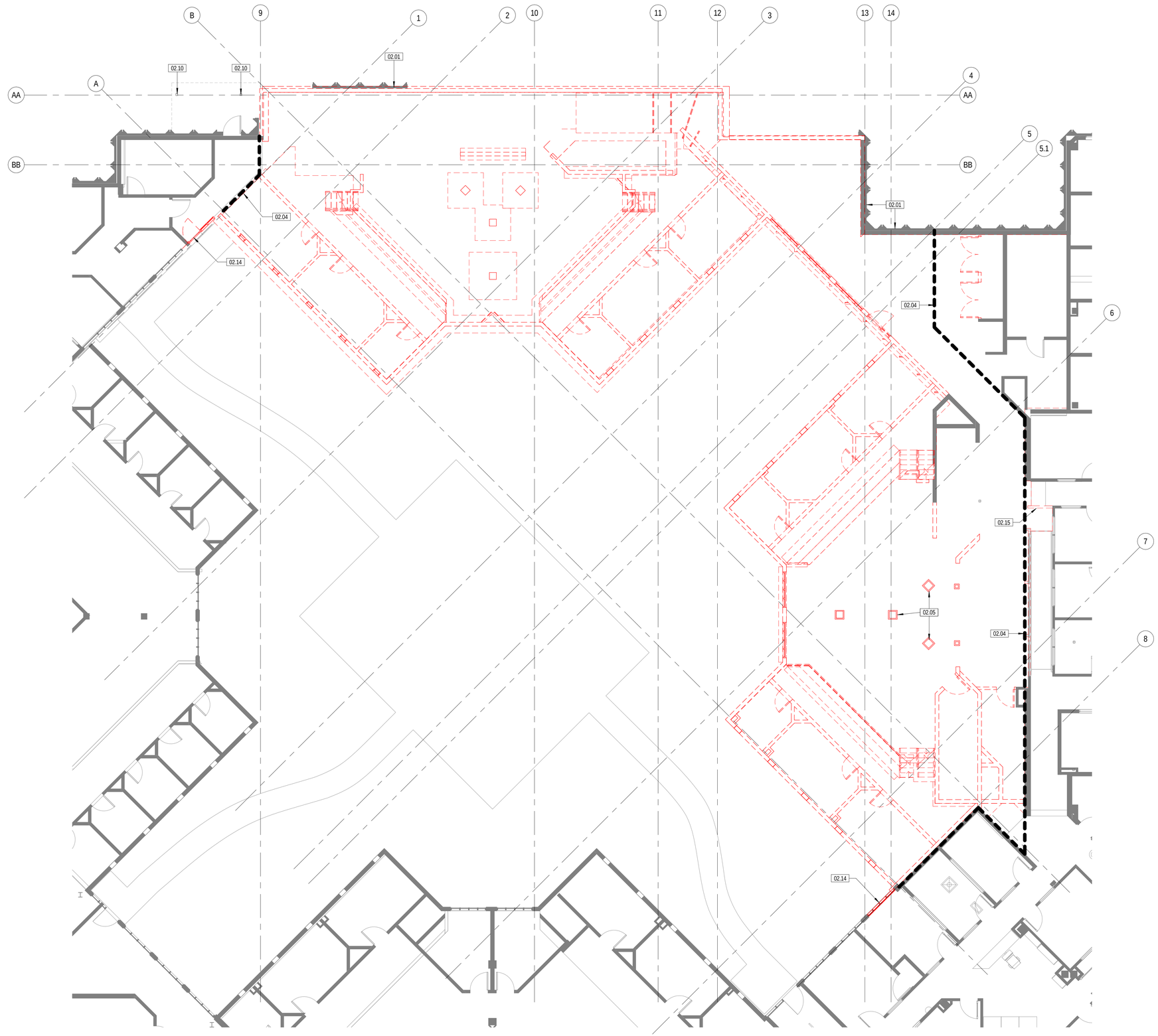
1	ADDENDUM 2	01/16/2018
2	PERMIT COMMENTS	06/01/2018

PARTITION TYPES AND CONSTRUCTION ASSEMBLIES

A 011



1 DEMOLITION PLAN - LEVEL 1
1/8" = 1'-0"

TRUE NORTH

PLAN NORTH

GENERAL NOTES - DEMOLITION

1. REMOVE ALL WALLS INDICATED BY THE FOLLOWING LINETYPE (UNLESS NOTED OTHERWISE)
2. EXISTING FLOOR AND JOISTS TO REMAIN INDICATED BY THE FOLLOWING HATCH

KEYNOTES

02.01	SALVAGE EXISTING PRE-CAST PANELS, STORE ON SITE FOR USE ON NEW ADDITION.
02.04	TEMPORARY CONSTRUCTION WALL, SEE WALL TYPE "T" ON A011
02.05	EXISTING COLUMNS TO REMAIN
02.10	EXISTING COLUMNS TO REMAIN
02.14	REMOVE EXISTING STOREFRONT
02.15	REMOVE EXISTING WALL

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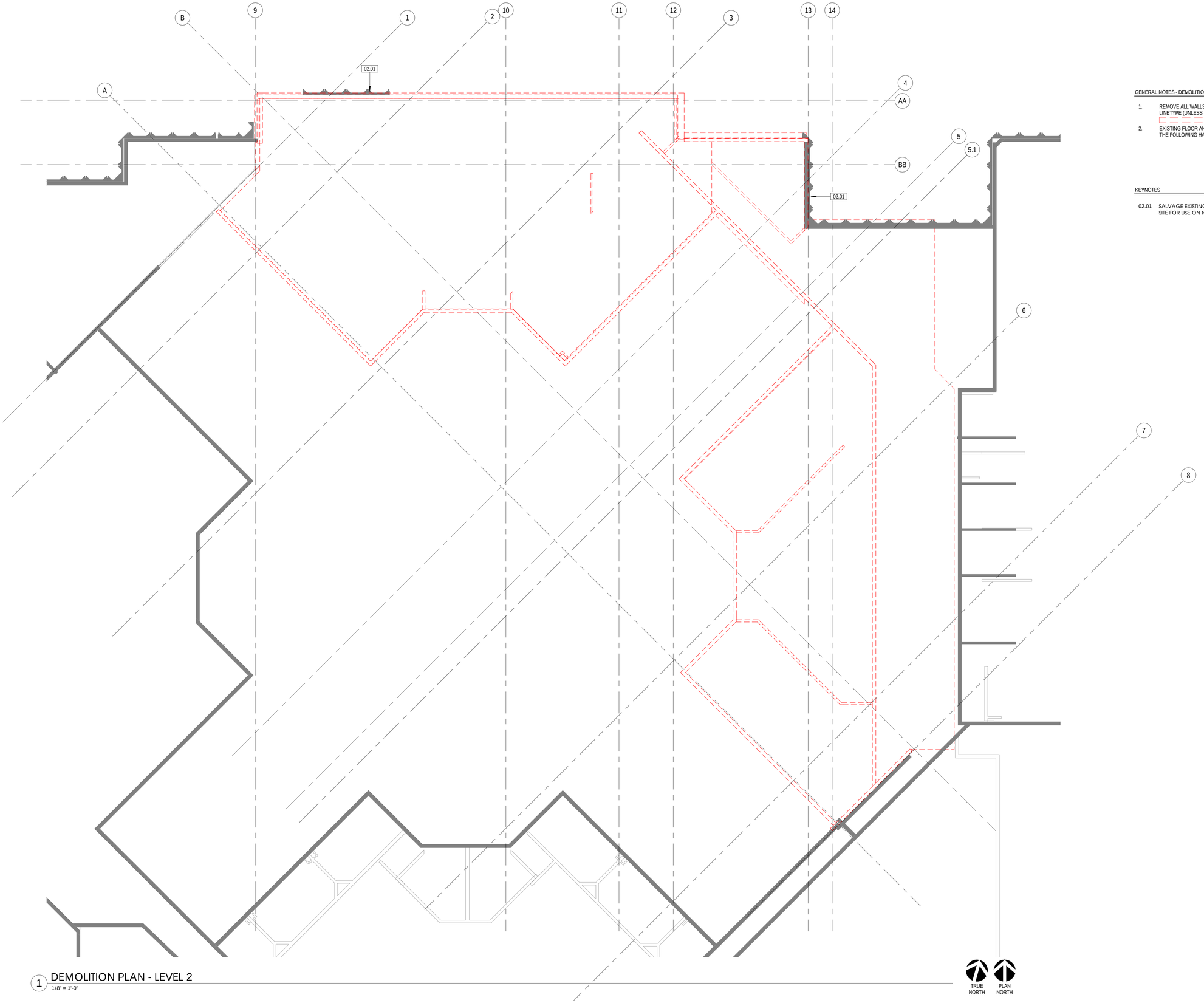
DEMOLITION PLAN - LEVEL 1

A
071



1 DEMOLITION PLAN - LEVEL 2
1/8" = 1'-0"

TRUE NORTH

PLAN NORTH

GENERAL NOTES - DEMOLITION

1. REMOVE ALL WALLS INDICATED BY THE FOLLOWING LINETYPE (UNLESS NOTED OTHERWISE)
2. EXISTING FLOOR AND JOISTS TO REMAIN INDICATED BY THE FOLLOWING HATCH

KEYNOTES

02.01 SALVAGE EXISTING PRE-CAST PANELS, STORE ON SITE FOR USE ON NEW ADDITION.

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STATE OF COLORADO
ROBERT LEWIS EKSTROM
400982
11/16/17
LICENSED ARCHITECT

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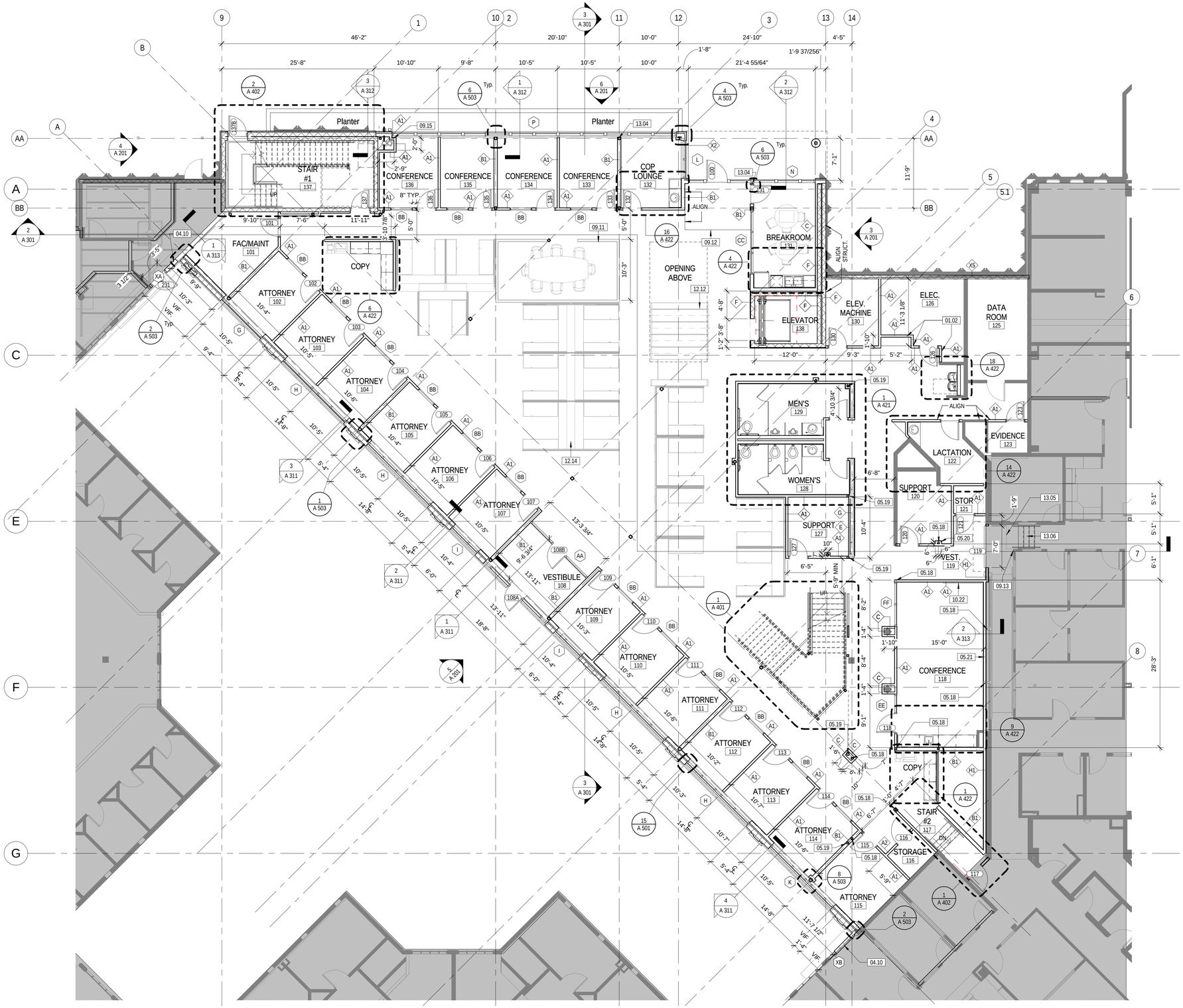
Rev. #	Description	Date

DEMOLITION PLAN - LEVEL 2

A
072



1 FLOOR PLAN - LEVEL 1
1/8" = 1'-0"

TRUE NORTH
PLAN NORTH

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KEYNOTES

01.02 ELECTRICAL ROOM - 126 DOOR AND WALLS TO BE INCLUDED AS PART OF CORE AND SHELL
04.10 INFILL PREVIOUS OPENING WITH 8" CMU, MATCH EXTERIOR AND INTERIOR FINISH WITH ADJACENT CONDITION. 1-HR MIN RATING
05.18 TYP. PROVIDE 2-HR SPRAY APPLIED FIRE RESISTIVE MATERIALS ON ALL STEEL COLUMNS AND BEAMS SUPPORTING EXISTING ROOF
05.19 NO FIRE RESISTIVE MATERIALS ON THESE COLUMNS
05.20 PROVIDE WALL TYPE "C" TO COVER STEEL COLUMNS, TYP.
05.21 MODIFIED H1 WALL ASSEMBLY, RE: 2/A313
09.11 72" TALL ACCOUSTICAL WALL SYSTEM BY TEKNION AS BASIS OF DESIGN - PROVIDED BY OWNER
09.12 WALKOFF MAT; RE: ROOM FINISH SCHEDULE
09.13 PATCH WALL AS REQUIRED. MATCH ADJACENT FINISH
09.15 PROVIDE A 1-HR SHAFT ENCLOSURE TO EXTERIOR WALL
10.22 4' x 6' MARKERBOARD
12.12 ROLLING FILES (12'L X 9'-8" WIDE X 84" TALL) - PROVIDED BY OWNER
12.14 TEKNION DESKING SYSTEM AS BASIS OF DESIGN - PROVIDED BY OWNER
13.04 EXTEND WALL TO MULLION PROVIDE ACOUSTIC GASKET AS REQ'D. TYP.
13.05 BUILD UP FLOOR TO MATCH NEW CONSTRUCTION LEVEL, MATCH NEW CONSTRUCTION FINISH
13.06 RELOCATE STAIR AND HANDRAILS. PATCH DAMAGED WALLS

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FLOOR PLAN - LEVEL 1

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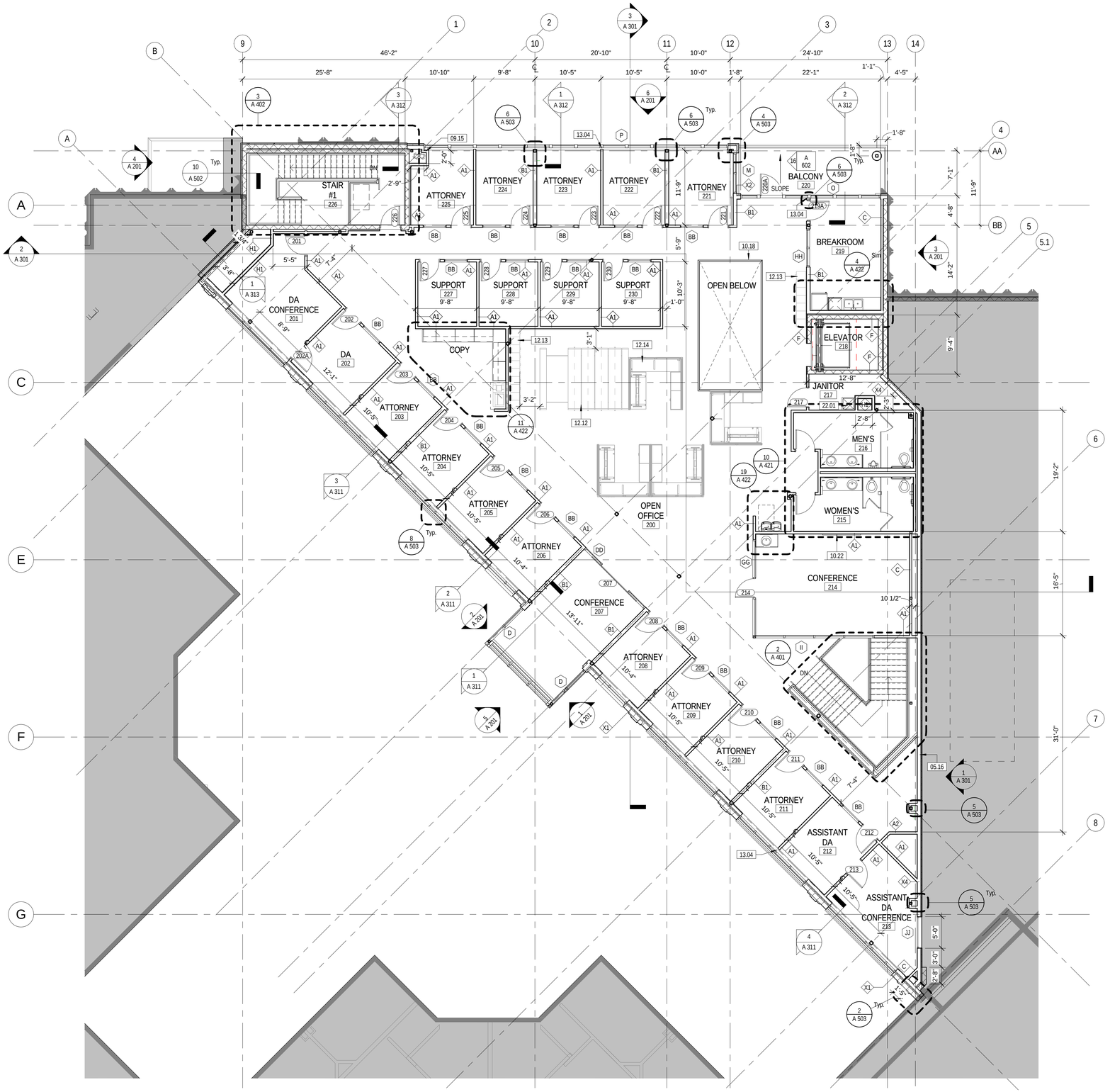
111



5 FLOOR PLAN - LEVEL 2
1/8" = 1'-0"

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KEYNOTES

05.16	STRUCTURAL WALL, RE: STRUCTURAL DRAWINGS
09.15	PROVIDE A 1-HR SHAFT ENCLOSURE TO EXTERIOR WALL
10.18	1 1/2" PAINTED STEEL PIPE GUARDRAIL, FLOOR MOUNTED
10.22	4' x 6' MARKERBOARD
12.12	ROLLING FILES (12'L X 9'-8" WIDE X 84" TALL) - PROVIDED BY OWNER
12.13	METAL LOCKERS - PROVIDED BY OWNER
12.14	TEKNION DESKING SYSTEM AS BASIS OF DESIGN - PROVIDED BY OWNER
13.04	EXTEND WALL TO MULLION PROVIDE ACOUSTIC GASKET AS REQ'D. TYP.
22.01	MOP SINK, RE: PLUMBING

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FLOOR PLAN - LEVEL 2

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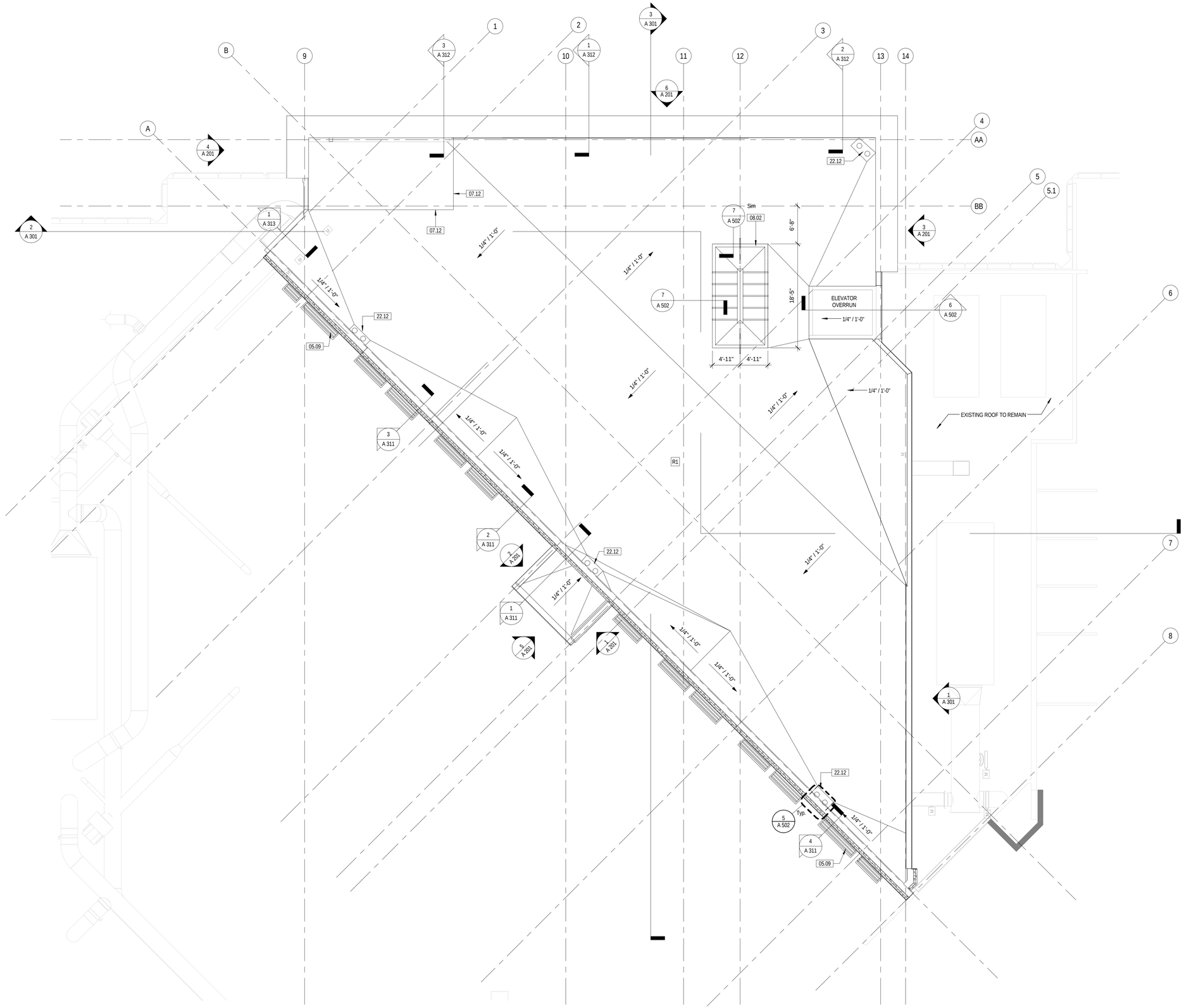
112



1 ROOF PLAN
1/8" = 1'-0"

TRUE NORTH

PLAN NORTH

GENERAL NOTES

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KEYNOTES

05.09	INTEGRATED SUNSHADE BY STOREFRONT MANUFACTURER
07.12	NON-RATED ELASTIC ROOF JOINT COVER, RE: 14/A501
08.02	PREFINISHED MANUFATURED SKYLIGHT, RE: SPECIFICAITON
22.12	ROOF DRAIN, RE: PLUMBING

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ROOF PLAN

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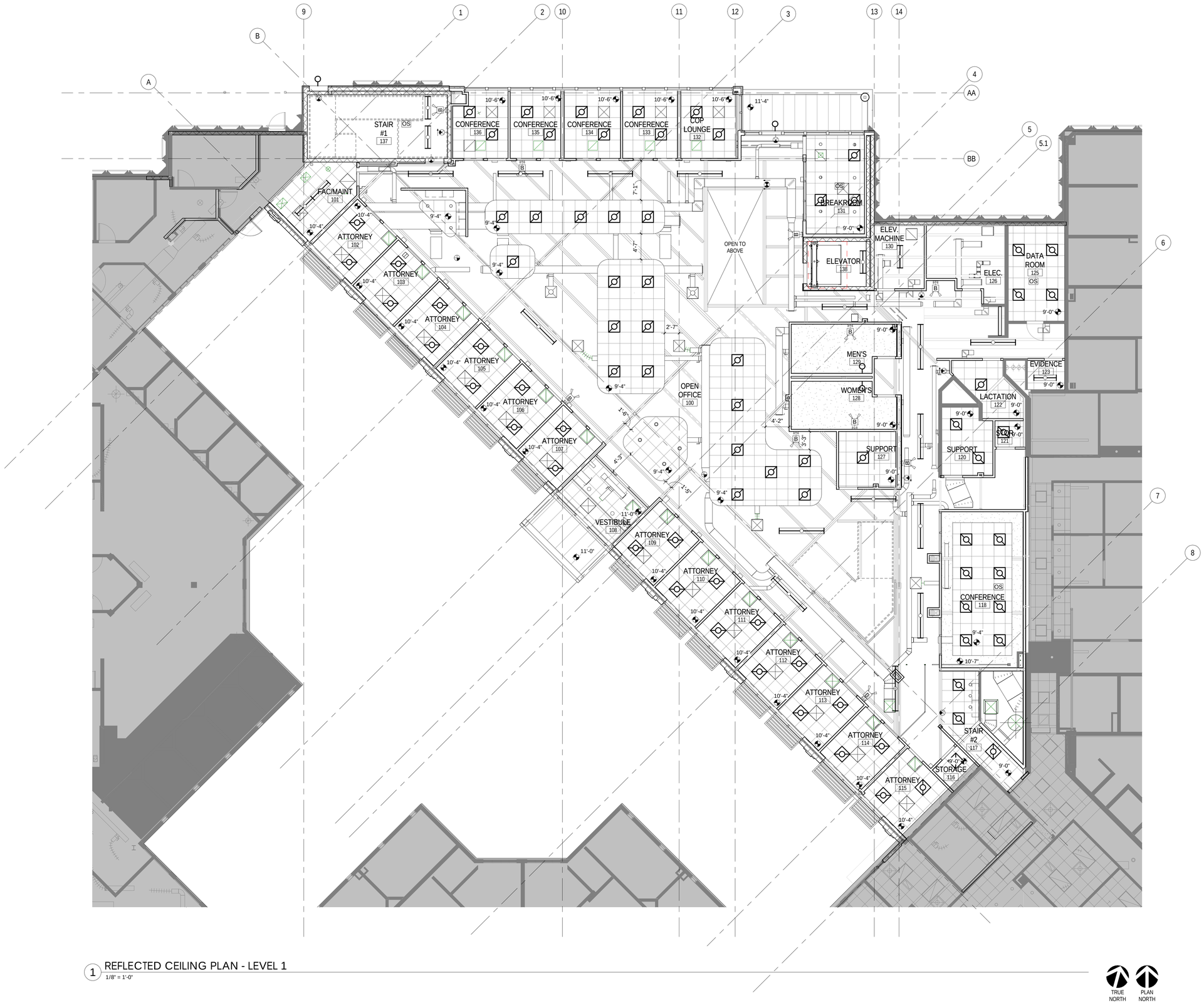
113



1 REFLECTED CEILING PLAN - LEVEL 1
1/8" = 1'-0"

TRUE NORTH

PLAN NORTH

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RCP LEGEND

1/8" = 1'-0"

- GYPSUM BOARD
- 2' x 2' SUSPENDED ACOUSTICAL PANELS
- 2' x 2' SUSPENDED WOOD PANELS
- METAL SOFFIT
- RETURN DIFFUSER
- SUPPLY DIFFUSER
- RECESSED CAN
- 2X2 LIGHT FIXTURE
- PENDANT LIGHTING
- CEILING MOUNTED STRIP LIGHTING

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JUSTICE CENTER DA INFILL

1777 6th St.
Boulder, CO 80302

SEH Project	135948
Project Manager	RE
Drawn By	CS/NM/TM
Project Status	Issue Date
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date
1	ADDENDUM 2	01/16/2018
2	PERMIT COMMENTS	06/01/2018

REFLECTED CEILING PLAN - LEVEL 1

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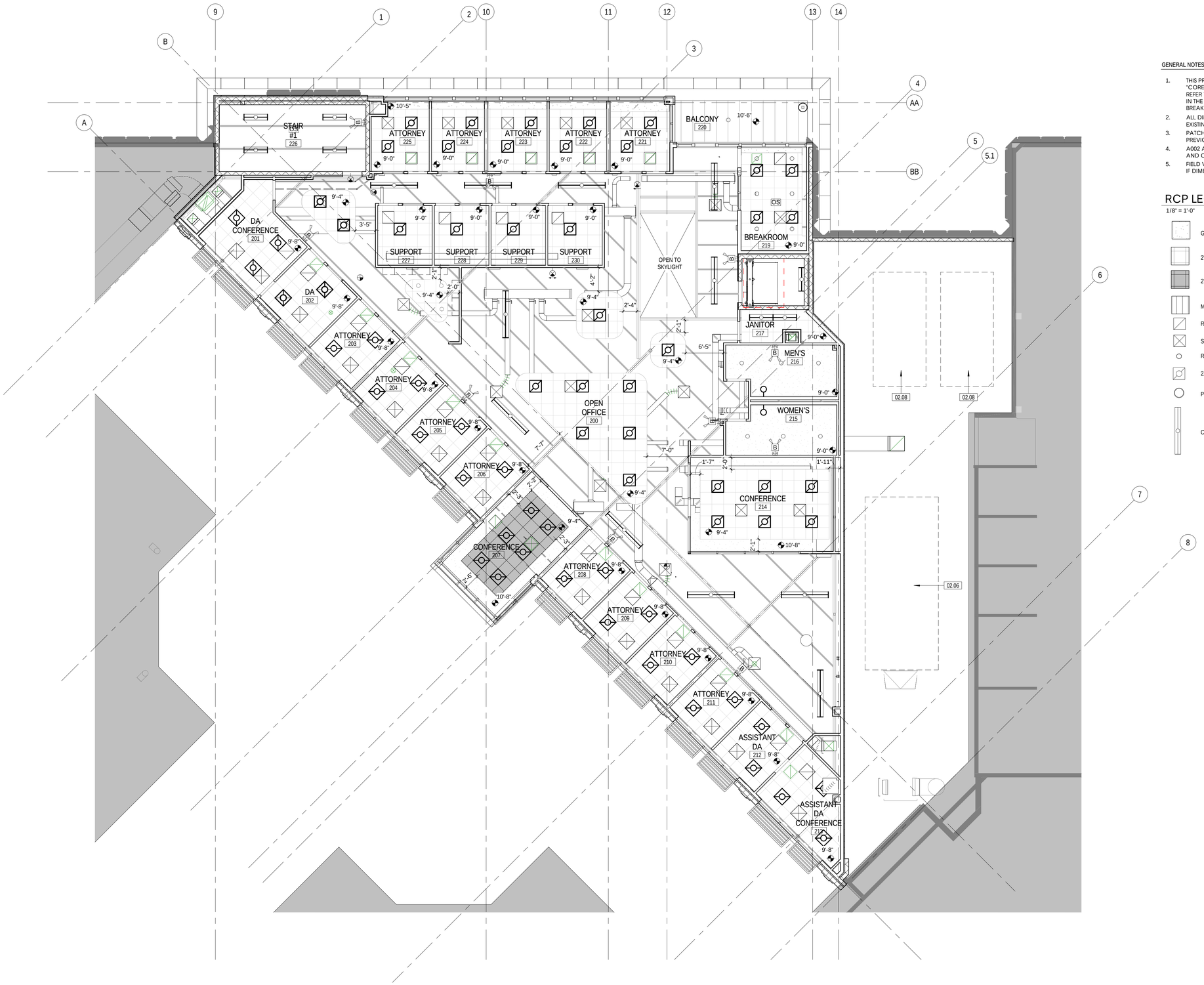
151



1 REFLECTED CEILING PLAN - LEVEL 2
1/8" = 1'-0"

TRUE NORTH
PLAN NORTH

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5. FIELD VERIFY ALL DIMENSIONS. NOTIFY ARCHITECT IF DIMENSIONS VARY SIGNIFICANTLY.

RCP LEGEND

1/8" = 1'-0"

- GYPSUM BOARD
- 2' x 2' SUSPENDED ACOUSTICAL PANELS
- 2' x 2' SUSPENDED WOOD PANELS
- METAL SOFFIT
- RETURN DIFFUSER
- SUPPLY DIFFUSER
- RECESSED CAN
- 2X2 LIGHT FIXTURE
- PENDANT LIGHTING
- CEILING MOUNTED STRIP LIGHTING

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REFLECTED CEILING PLAN - LEVEL 2

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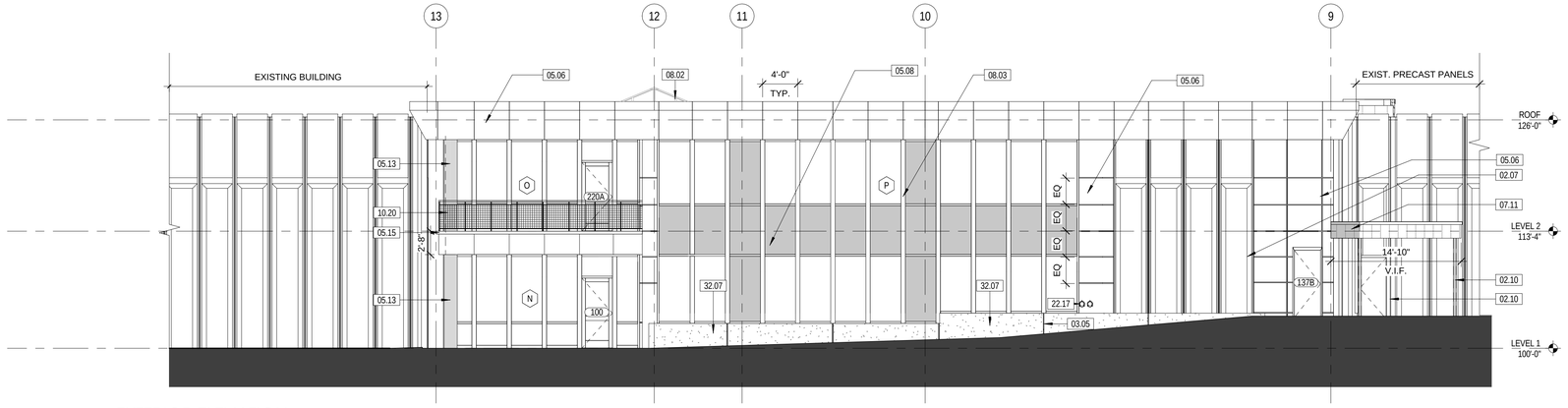
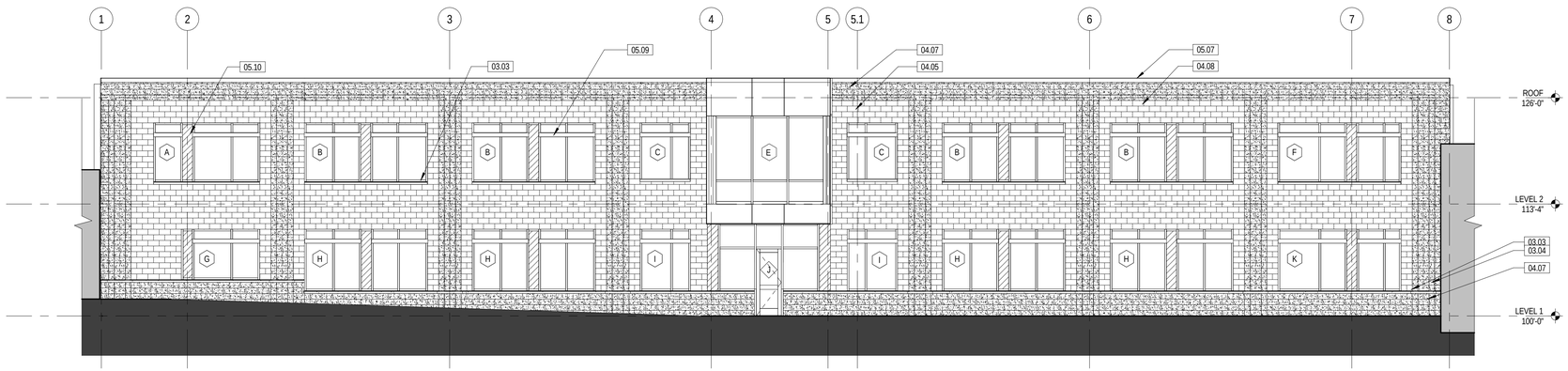


6 EXTERIOR ELEVATION
1/8" = 1'-0"



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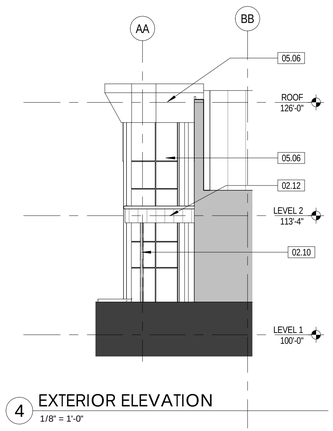
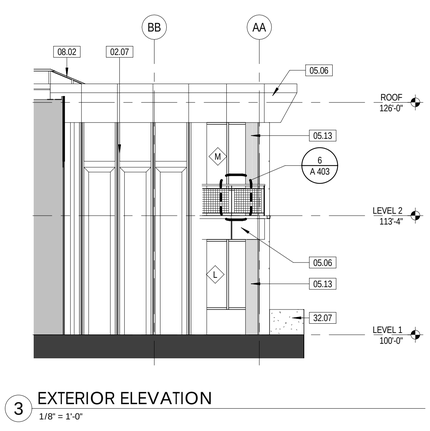
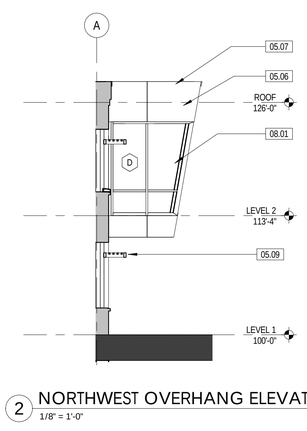
1/8" = 1'-0"



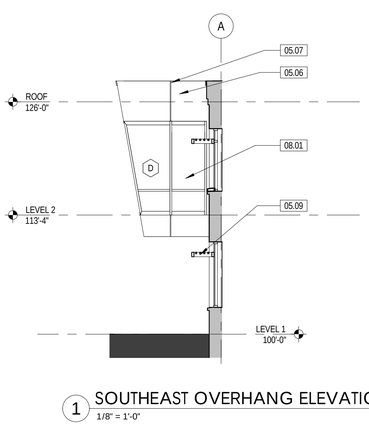
4 EXTERIOR ELEVATION
1/8" = 1'-0"



3 EXTERIOR ELEVATION
1/8" = 1'-0"



2 NORTHWEST OVERHANG ELEVATION - S
1/8" = 1'-0"



1 SOUTHEAST OVERHANG ELEVATION - S
1/8" = 1'-0"

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KEYNOTES

02.07	REINSTALL SALVAGED PRECAST PANELS
02.10	EXISTING COLUMNS TO REMAIN
02.12	EXISTING METAL FASCIA TO REMAIN
03.03	PRECAST CONCRETE SILL
03.04	PRECAST CONCRETE PILASTER CAP
03.05	
04.05	GROUND FACE CMU
04.07	SPLIT FACE CMU
04.08	CORBEL AT CORNICE
05.06	COMPOSITE ALUMINUM PANEL
05.07	PREFINISHED METAL PARAPET CAP
05.08	SPANDREL PANEL - BRONZE TINTED GLAZING
05.09	INTEGRATED SUNSHADE BY STOREFRONT MANUFACTURER
05.10	ALUMINUM BREAK METAL WIDE MULLION TO CONCEAL OFFICE WALL/STRUCTURAL COLUMN INTERSECTION WITH WINDOW SYSTEM
05.13	CIRCULAR COLUMN COVER, MATCH METAL PANEL SYSTEM
05.15	PREFINISHED METAL GUTTER, MATCH WALL PANEL COLOR AND FINISH
07.11	REBUILD METAL FASCIA TO MATCH EXISTING
08.01	CURTAIN WALL WINDOW SYSTEM
08.02	PREFINISHED MANUFATURED SKYLIGHT, RE: SPECIFICAITON
08.03	CURTAIN WALL WINDOW SYSTEM - CLEAR ANODIZED WITH BRONZE TINTED GLAZING
10.20	1 1/2" STEEL PIPE GUARDRAIL, MESH PANEL BASE; GLASS PANEL BASE ATL.
22.17	ROOF DRAIN AND OVERFLOW DRAIN LAMB'S TONGUES, REI PLUMBING
32.07	CAST IN PLACE EXPOSED AGGREGATE PLANTER WALL

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2	ADDENDUM 2	01/16/2018
3	PERMIT COMMENTS	06/01/2018

ELEVATIONS

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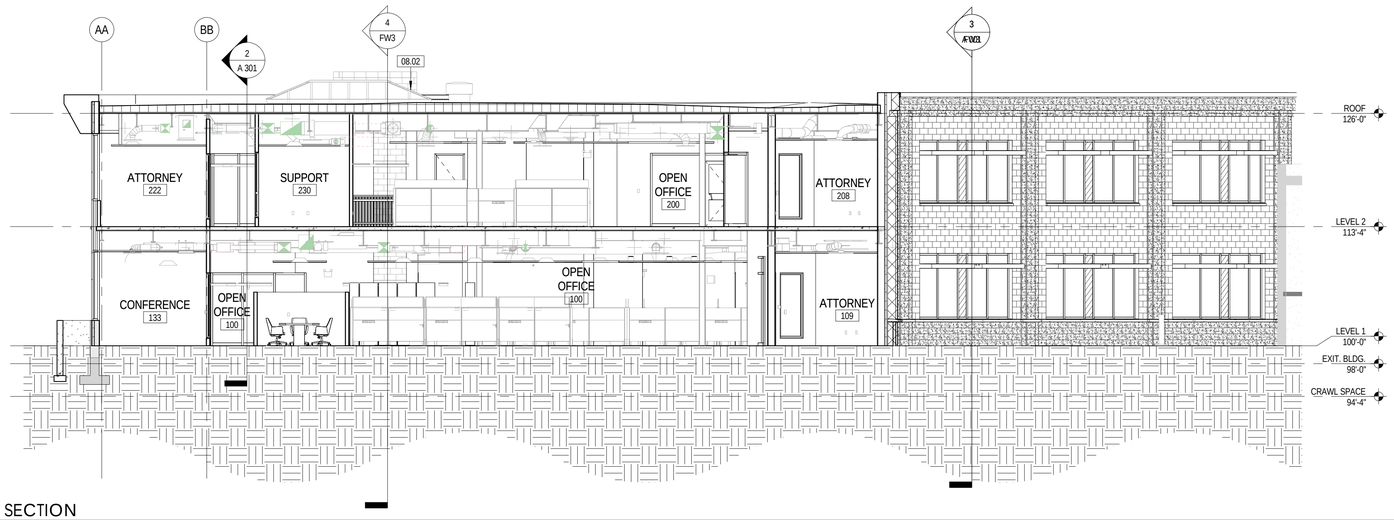
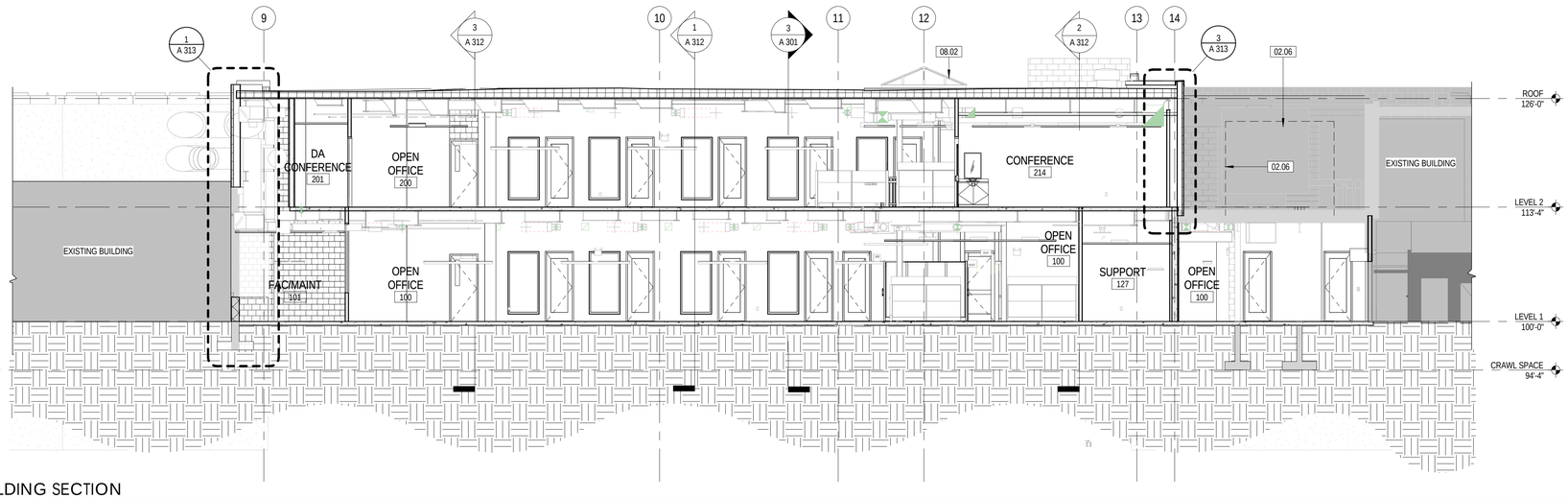
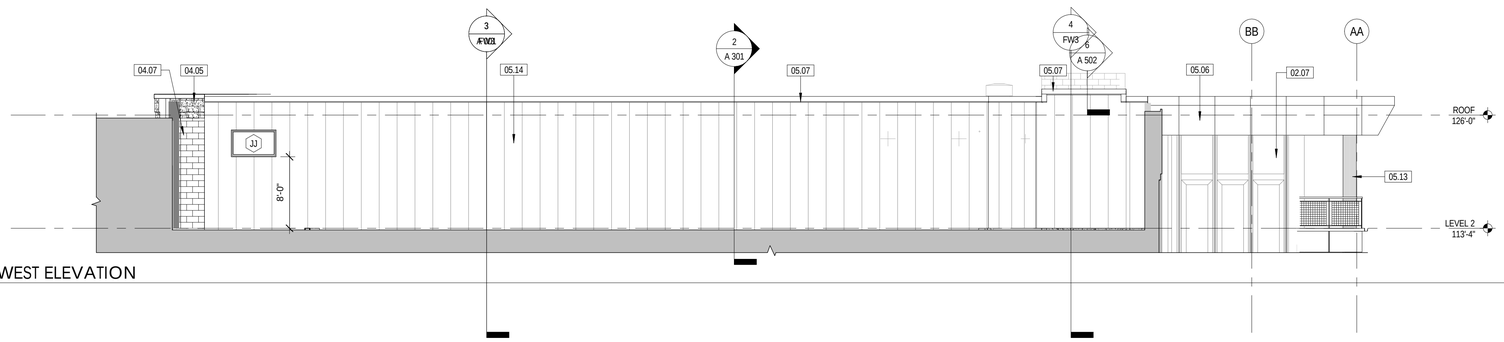


3 BUILDING SECTION
1/8" = 1'-0"



2 BUILDING SECTION
1/8" = 1'-0"



1 PARTIAL WEST ELEVATION
1/8" = 1'-0"

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KEYNOTES

02.06	EXISTING AHU, RE: MECHANICAL
02.07	REINSTALL SALVAGED PRECAST PANELS
04.05	GROUND FACE CMU
04.07	SPLIT FACE CMU
05.06	COMPOSITE ALUMINUM PANEL
05.07	PREFINISHED METAL PARAPET CAP
05.13	CIRCULAR COLUMN COVER, MATCH METAL PANEL SYSTEM
05.14	INSULATED METAL PANEL; BASIS OF DESIGN; FORMAWALL DIMENSIONAL SERIES 2"
08.02	PREFINISHED MANUFATURED SKYLIGHT, RE: SPECIFICAITON

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BUILDING SECTIONS

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301

STRUCTURAL GENERAL NOTES

DESIGN LOADS: 2012 International Building Code with City of Boulder Amendments, ASCE 7-10

Risk Category III Substantial Hazard

Roofs:

Roof Dead Load		30 psf
Live Load		20 psf
Ground Snow Load	Pg	30 psf
Flat-roof Snow Load	Pf	30 psf
Snow Exposure Factor	Ce	1.0
Snow Importance Factor	I	1.1
Thermal Factor	Ct	1.0

Floor Live Loads:

Occupancy or Use	Uniformly Distributed (psf)	Concentrated (lbs)	Live Load Reduction
Office	50	2,000	Yes
Office Partitions	15	N/A	
Public Spaces	100	2,000	
First Floor Corridors	100	N/A	
Rolling Files/ 2nd Floor Entire Area	175	N/A	
Storage Areas	125	N/A	
Balconies and Decks	Same As Occupancy Served	N/A	Same As Occupancy Served

Wind:

Ultimate Design Wind Speed, Vult, (3-second gust)	175 mph	
Nominal Design Wind Speed, Vasd, (3-second gust)	130 mph	
Internal Pressure Coefficient	0.18 (Enclosed)	
Wind Exposure	C	
Components and Cladding Design Wind Pressures		
Walls:		
Within 10.3 feet of corners	+58.8 psf	-78.4 psf
Away from corners	+58.8 psf	-63.7 psf
Parapets:		
Within 10.3 feet of corners	+179.5 psf	-104.8 psf
Away from corners	+131.0 psf	-91.7 psf
Roofs:		
Within 10.3 feet of corners	+26.1 psf	-162.2 psf
Within 10.3 feet of edges	+26.1 psf	-107.8 psf
Away from edges	+26.1 psf	-64.2 psf
Overhangs:		
Within 10.3 feet of corners	+26.1 psf	-162.2 psf
Away from corners	+26.1 psf	-102.4 psf

Pressures may be reduced for effective wind areas larger than 10 square feet, but not below 16 psf.

Seismic:

Spectral Response Acceleration Parameters		
Short Period	Ss 0.202g	SDS 0.215g
One Second	S1 0.061g	SD1 0.098g
Soils Site Class	D	
Seismic Importance Factor	1.25	
Seismic Design Category	B	
Basic Seismic-Force-Resisting System(s)	Intermediate reinforced masonry shear walls, Ordinary reinforced concrete shear walls and Steel systems not specifically detailed for seismic resistance	
Design Base Shear(s)	79 kips	
Seismic Response Coefficient(s), Cs	0.09	
Response Modification Coefficient(s), R	3	
Analysis Procedure	Equivalent Lateral Force	

FOUNDATION DESIGN:
Geotechnical Engineer shall verify soil conditions and types during excavation and prior to placement of formwork or concrete.

FOOTINGS:
Design of footings is based on maximum allowable bearing pressure = 2,000 psf after compaction grouting
Bear on the natural undisturbed soil or compacted structural fill. Exterior footings shall bear below frost depth; minimum frost depth shall be 3'-0 below exterior grade.

REINFORCED CONCRETE:
Design is based on ACI 318 "Building Code Requirements for Reinforced Concrete."
Concrete work shall conform to ACI 301 "Standard Specifications for Structural Concrete."

Structural concrete shall have the following properties:

Intended use	f'c, psi 28 day	Max W/C Ratio	Max Aggregate	Slump, inches (+/- 1")	Entrained Air, percent (+/- 1.5%)	Cement Type	Admixtures, Comments
Footings	3,000	0.52	3/4" Stone	5	2	I/II	
Stem Walls	4,500	0.42	3/4" Stone	4	5	I/II	
Walls	4,000	0.45	3/4" Stone	4	3	I/II	
Structural slab on deck	3,500	0.50	3/4" Stone	4	3	I	
Interior slabs on grade	4,000	0.45	3/4" Stone	4	3	I/II	

Slumps may be increased with use of mid or high range water-reducing admixture.
Detailing, fabrication, and placement of reinforcing steel shall be in accordance with ACI 315 "Details and Detailing of Concrete Reinforcement."
Reinforcing bars shall conform to ASTM A615, Grade 60, except ties or bars shown to be field-bent, which shall be Grade 40.
Bars to be welded shall conform to ASTM A706.
At corners and intersections, make horizontal bars continuous or provide matching corner bars for each layer of reinforcement.
Trim openings in walls and slabs with 2-#5 for each layer of reinforcement, fully developed by extension or hook.
Form intermittent shear keys at all construction joints and as shown on the Structural drawings.
Except as noted on the drawings, concrete protection for reinforcement in cast-in-place concrete shall be as follows:

Cast against and permanently exposed to earth:	3"
Exposed to earth or weather:	
#6 through #18 bars	2"
#5 bar, W31 or D31 wire, and smaller	1-1/2"
Not exposed to weather or in contact with ground:	
Slabs, walls, joists: #11 bars and smaller	3/4"
Beams and columns:	
Primary reinforcement	1-1/2"
Stirrups, ties, spirals	1-1/2"

Anchor bolts and rods for beam and column-bearing plates shall be placed with setting templates.
Fiber admixture shall be 100% virgin polypropylene, fibrillated fibers, Type III 4.1.3 performance level one, per ASTM C1116.

STRUCTURAL STEEL:
Structural steel shall be detailed, fabricated, and erected in accordance with the "Specification for Structural Steel Buildings" (AISC 360) and the "Code of Standard Practice for Steel Buildings and Bridges" (AISC 303) by the American Institute of Steel Construction (AISC).
Structural steel wide flange beams shall conform to ASTM A992, 50 ksi yield.
Rolled steel floor plates shall conform to ASTM A786, Commercial Grade.
Other rolled shapes, including plates, channels, WTs, and angles shall conform to ASTM A36, 36 ksi yield.
Hollow structural section (HSS) rectangular shapes shall conform to ASTM A500, Grade B, 46 ksi yield.
HSS round shapes shall conform to ASTM A500, Grade B, 42 ksi yield.
Pipe shapes shall conform to ASTM A53, Grade B, 35 ksi yield.
Except as noted, framed beam connections shall be bearing-type with 3/4" diameter, snug tight, ASTM A325 bolts, detailed in conformance with the Structural Drawings and the "Steel Construction Manual" by the AISC, 13th Edition. Install bolts in accordance with AISC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
All beams shall have full depth web stiffeners each side of webs above and below columns.
Anchor rods shall conform to ASTM F1554, Grade (36, 55, and/or 105) as noted on the Structural Drawings with weldability supplement S1.
Headed anchor studs (HAS) shall conform to ASTM A108 and shall be connected to structural steel with equipment approved by the stud manufacturer according to the stud manufacturer's recommendations.
Welding shall be done by a certified welder in accordance with the AISC documents listed above, the American Welding Society (AWS) D1.1: Structural Welding Code, and the recommendations for use of weld E70 electrodes. Where not specifically noted, minimum weld shall be 3/16" Fillet by length of contact edge.
All post-installed anchors shall have current International Code Council Evaluation Service (ICC-ES) reports and shall be installed in accordance with the manufacturer's requirements.
Expansion anchors shall be approved "wedge" type unless specifically noted to be "sleeve" type as noted on the Structural Drawings.
Chemical anchors shall be approved epoxy or similar adhesive type as appropriate for installation in solid and non-solid base materials.
Grout beneath column base and beam bearing plates shall have a minimum 28-day, compressive strength of 7,500 psi and shall be non-shrink, non-metallic, and tested in accordance with ASTM C1107.

STEEL DECKING:
Steel roof, non-composite floor (or 'form'), and composite floor deck shall be manufactured and erected in accordance with the standard deck specifications and the "Manual of Construction with Steel Deck" (SDI No. MOC1) as prepared by the Steel Deck Institute (SDI).
Roof deck shall be connected to supporting members and interconnected as noted on the Structural Drawings.
Non-composite and composite floor deck shall be connected to supporting members and interconnected as required to satisfy SDI minimum requirements except as noted on the Structural Drawings.
Welding patterns, screw patterns, and details shall be indicated on the deck supplier's shop drawings.

LIGHT GAUGE STRUCTURAL STEEL FRAMING:
Member forming shall conform to AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
All structural framing (studs, joists, track, runners, bracing, and bridging) shall be galvanized G-60 sheet steel conforming to ASTM A1003.
Studs and joists 54 mils (16 gauge) and heavier shall be 50 ksi yield. 43 mils (18 gauge) and lighter shall be 33 ksi yield unless noted.
Subcontractor shall provide bridging and blocking at a maximum of 6 foot spacing or as required for stability and stiffness of the final assembly wherever sheathing does not provide adequate bracing.
Where punchouts are within 8" of member ends, install unpunched stiffeners with 4-#10 screws each edge to the stiffened member.
Parallel members in contact shall have #10 screws @ 16" max along each contact edge in the field of the member.
The SSMA product identification codes are used to label members on the drawings:
[Member Depth in 1/100 inches][Style][Flange Width in 1/100 inches]-[Material Thickness in mils] [Yield Strength ksi]

Minimum Thickness (mils)	Reference Only Gauge No.	Style	Section
33	20 - Structural	S	Stud or Joist
43	18	T	Track
54	16	U	Channel
68	14	F	Furring Channel
97	12		

STRUCTURAL MASONRY:
Design is based on ACI 530/ASCE 5/TMS 402, "Building Code Requirements for Masonry Structures," Allowable Stress Design.
28-day compressive strength of masonry assembly used for design is 2000 psi, based on net-bedded area.
Except at masonry lintels using standard lintel units, bond beam units shall be produced from standard vertically voided units with pre-cut knockout cross walls.
Hollow load-bearing concrete masonry units (CMU) shall be lightweight, 85 to 105 pcf density, conforming to ASTM C90, with a minimum 28-day compressive strength of 2,800 psi based on average net area.
Mortar shall be Type S conforming to ASTM C270.
Masonry cement shall not be used unless part of a pre-packaged mortar or grout mix approved by the Structural Engineer.
Admixtures shall not be used unless approved by the Architect and/or Structural Engineer.
Grout used in masonry walls and block cells shall be coarse grout, as defined by Article 2.4 of TMS 602/ACI 530.1/ASCE 6, with a minimum 28-day strength = 2,000 psi or 3,000 psi concrete using 3/8" diameter aggregate and placed by vibrating unless an approved self-consolidating mix is used.
Placement of mortar, grout, masonry units and wall ties shall comply with TMS 602/ACI 530.1/ASCE 6.
Provide full shoved mortar in all head and bed joints.
'Low-lift' grouting shall not exceed 5 feet in height unless ACI 530.1 'high-lift' grouting procedures are reviewed and approved by the Architect and Structural Engineer.
Vertically space continuous horizontal joint reinforcing at 16" maximum in all CMU walls. Joint reinforcing shall be welded type with 9 gage side rods and 9 gage trussed or ladder cross rods. In exterior walls, joint reinforcement shall be stainless steel or hot-dip galvanized. All other joint reinforcement shall be mill galvanized, hot-dip galvanized, or stainless steel.
Wire ties for veneer shall be 9 gage diameter for cavity widths 2" or less. Where nominal cavity width exceeds 2 inches, veneer ties shall be 1/4" diameter. Ties shall be spaced a maximum of 16" in each direction.
Reinforcing bars shall be as for reinforced concrete except as noted. Unless otherwise noted on the Structural Drawings, lap bars 50 diameters (minimum) at splices. Reinforcement shall be secured against displacement prior to grouting by wire bar locators or other suitable devices at intervals not exceeding 200 bar diameters or 10 feet.
Reinforce and grout vertical cells at corners, ends of walls, jambs of openings, each side of vertical control joints, and at spacing shown on drawings.
Where noted on the drawings, provide clearance between masonry and structural elements, or wrap steel with polyethylene film.
Locate vertical control joints in all masonry walls as shown on the Architectural Drawings, Structural Drawings, or spaced horizontally at 25'-0 maximum spacing where not shown.

SHOP DRAWINGS:
The Structural Drawings are copyrighted and shall not be copied for use as erection plans or shop details. Use of JVA's electronic files as the basis for shop drawings requires prior approval by JVA, a signed release of liability by the General Contractor and/or his subcontractors, and deletion of JVA's name and logo from all sheets so used.
The General Contractor shall submit in writing any requests to modify the Structural Drawings or Project Specifications.
All shop and erection drawings shall be checked and stamped (after having been checked) by the General Contractor prior to submission for Structural Engineer's review; shop drawing submittals not checked by the General Contractor prior to submission to the Structural Engineer will be returned without review.
Furnish two (2) prints of shop and erection drawings to the Structural Engineer for review prior to fabrication for reinforcing steel, structural steel, steel joists, steel form, floor, and roof deck.
Submit in a timely manner to permit 10 working days for review by the Structural Engineer.
Shop drawings submitted for review do not constitute "request for change in writing" unless specific suggested changes are clearly marked. In any event, changes made by means of the shop drawing submittal process become the responsibility of the one initiating the change.

FIELD VERIFICATION OF EXISTING CONDITIONS:
The General Contractor shall thoroughly inspect and survey the existing structure to verify conditions that affect the work shown on the drawings.
The General Contractor shall report any variations or discrepancies to the Architect and Structural Engineer before proceeding.

STRUCTURAL ERECTION AND BRACING REQUIREMENTS:
The Structural Drawings illustrate and describe the completed structure with elements in their final positions, properly supported, connected, and/or braced.
The Structural Drawings illustrate typical and representative details to assist the General Contractor. Details shown apply at all similar conditions unless otherwise indicated. Although due diligence has been applied to make the drawings as complete as possible, not every detail is illustrated and not every exceptional condition is addressed.
All proprietary connections and elements shall be installed in accordance with the manufacturers' recommendations.
All work shall be accomplished in a workmanlike manner and in accordance with the applicable codes and local ordinances.
The General Contractor is responsible for coordination of all work, including layout and dimension verification, materials coordination, shop drawing review, and the work of subcontractors. Any discrepancies or omissions discovered in the course of the work shall be immediately reported to the Architect and Structural Engineer for resolution. Continuation of work without rectification of discrepancies relieves the Architect and Structural Engineer from all consequences.
Unless otherwise specifically indicated, the Structural Drawings do not describe methods of construction.
The General Contractor, in the proper sequence, shall perform or supervise all work necessary to achieve the final completed structure; and to protect the structure, workmen, and others during construction. Such work shall include, but not be limited to temporary bracing, shoring for construction equipment, shoring for excavation, formwork, scaffolding, safety devices and programs of all kinds, support and bracing for cranes and other erection equipment.
Do not backfill against basement or retaining walls until supporting slabs and floor framing are in place and securely anchored, unless adequate temporary bracing is provided.
Temporary bracing shall remain in place until all floors, walls, roofs and any other supporting elements are in place.
The Architect and Structural Engineer bear no responsibility for the above items, and observation visits to the site do not in any way include inspections of these items.

DEFERRED SUBMITTALS:
Portions of the structure have elements of proprietary design and fabrication, which shall be submitted by the supplier for approval after award of contract.
These items shall conform to the load, capacity, size, geometry, connection, and support criteria noted on the Structural Drawings.
Shop drawings and calculations submitted shall be prepared by an engineer registered in the state of Colorado. Final shop drawing submittals shall be stamped and signed.
Furnish deferred submittals for:
compaction grouting
plant-cast concrete
steel joists
steel deck
supplier engineered stairs
supplier design steel connections
Submittals will be reviewed by the Structural Engineer of Record for compliance with the specified design requirements, stamped as "Reviewed," and forwarded to the local building authority for review as required.
Final issue of the Building Permit may, at the approval authority's option, be contingent on its acceptance of the deferred submittal documents.
Deferred submittal items shall not be installed until their design calculations and drawings have been reviewed by the Architect, Structural Engineer, and/or local building authority as required.

LETTERS OF CONSTRUCTION COMPLIANCE:
The General Contractor shall determine from the local building authority, at the time the building permit is obtained, whether any letters of construction compliance will be requested from the Structural Engineer.
The Contractor shall notify the Structural Engineer of all such requirements in writing prior to the start of construction.
Two day advance notice shall be given when requesting site visits necessary as the basis for the compliance letter.
The General Contractor shall provide copies of all third-party testing and inspection reports to the Architect and Structural Engineer a minimum of one week prior to the date that the compliance letter is needed.

SPECIAL INSPECTIONS:
The following Special Inspections and Testing shall be performed by a qualified Special Inspector, retained by the Owner, in accordance with the following sections of IBC Chapter 17:

Section 1704 Special Inspections, Contractor Responsibility, and Structural Observations and the following sub-sections:
1704.2 Special Inspections
1704.3 Statement of Special Inspections
Section 1705 Required Verification and Inspection and the following sub-sections:
1705.2 Steel Construction
1705.3 Concrete Construction
1705.4 Masonry Construction, Level II Special Inspection
1705.6 Soils
1705.10 Special inspections for wind resistance
Compaction Grouting

The Special Inspector shall be a qualified person who shall demonstrate competence, to the satisfaction of the building official, for inspection of the particular type of construction or operation requiring special inspection. The special inspector must be independent from the contractor responsible for the work being inspected.

Duties and responsibilities of the Special Inspector shall be to inspect and/or test the work outlined above and within the Statement of Special Inspections in accordance with Chapter 17 of the IBC for conformance with the approved construction documents. All discrepancies shall be brought to the immediate attention of the contractor for correction.

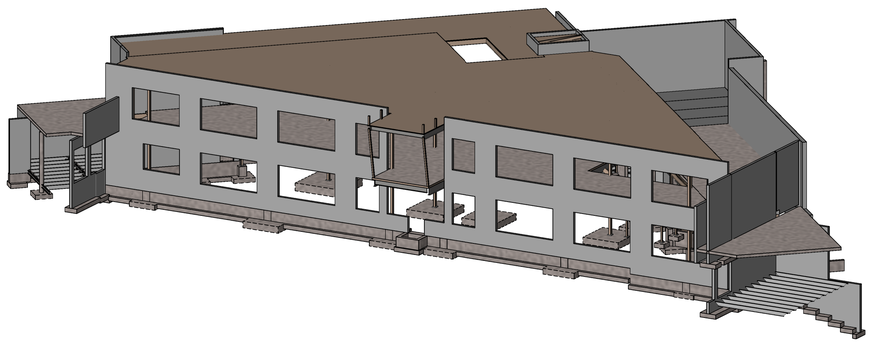
Per Section 1704.2.4 the Special Inspector shall furnish regular reports to the building official and the Structural Engineer. Progress reports for continuous inspection shall be furnished weekly. Individual reports of periodic inspections shall be furnished within one week of inspection dates. The reports shall note uncorrected deficiencies, correction of previously reported deficiencies, and changes to the approved construction documents authorized by the Structural Engineer of Record.

The Special Inspector shall submit a final signed report within 10 days of the final special inspection stating whether the work requiring special inspection was, to the best of the inspector's knowledge, in conformance with the approved construction documents and the applicable workmanship provisions of the IBC. Work not in compliance shall be noted in the report.

The Contractor shall submit a written statement of responsibility to the Building Official and the Owner prior to the commencement of work on a main wind- or seismic-force-resisting system per section 1704.4. The statement shall acknowledge the awareness of the special listed requirements of designated seismic system or a wind- or seismic-resisting component in the Statement of Special Inspections per section 1705.

Except as noted, the special inspections outlined above are in addition to, and beyond the scope of, periodic Structural Observations as defined in section 1704.5. Structural Observations are included in the structural engineering design and construction administration services provided by the Structural Engineer.

FIELD VERIFICATION:
- ALL DIMENSIONS AND CONDITIONS SHALL BE FIELD VERIFIED BY CONTRACTOR'S SURVEYOR PRIOR TO START OF FABRICATION
- IF DIMENSIONS AND CONDITIONS DIFFER THAN THOSE SHOWN ON DRAWINGS, NOTIFY ARCHITECT AND ENGINEER
- NOTIFY ARCHITECT AND ENGINEER ONCE FINISHES ARE REMOVED & FOUNDATION IS EXCAVATED TO ALLOW OBSERVATION



ABBREVIATIONS KEY

@	ON CENTER SPACING	DT	DOUBLE TEE	K	KIP (1,000 LBS)	REINF	REINFORCE, -ED, -ING
(E)	EXISTING	DWG	DRAWING	LL	LIVE LOAD	REQ	REQUIRED
(N)	NEW	DWL	DOWEL	LLH	LONG LEG HORIZONTAL	REQMT	REQUIREMENT
(R)	REMOVE	EA	EACH	LLV	LONG LEG VERTICAL	RET	RETAINING
AB	ANCHOR ROD (BOLT)	ECC	ECCENTRIC	LOC	LOCATION	RM	ROOM
ADDL	ADDITIONAL	E-E	END TO END	LP	LOW POINT	RMO	ROUGH MASONRY OPENING
ADJ	ADJUSTABLE	EF	EACH FACE	LSL	LAMINATED STRAND LUMBER (GENERIC TERM)	RO	ROUGH OPENING
AESS	ARCHITECTURALLY EXPOSED STRUCTURAL STEEL	EJ	EXPANSION JOINT	LT	LIGHT	SC	SLIP-CRITICAL
AFF	ABOVE FINISHED FLOOR	EL	ELEVATION	LVL	LAMINATED VENEER LUMBER (GENERIC TERM)	SCH	SCHEDULE
ALT	ALTERNATE	ELEC	ELECTRIC, ELECTRICAL	MACH	MACHINE	SDST	SELF-DRILLING/ SELF-TAPPING
AMT	AMOUNT	EMBED	EMBEDMENT	MASY	MASONRY	SECT	SECTION
ANCH	ANCHOR, ANCHORAGE	ENGR	ENGINEER	MATL	MATERIAL	SF	SQUARE FEET, SUB-FLOOR
APPROX	APPROXIMATE	EQ	EQUAL	MAX	MAXIMUM	SHT	SHEET
ARCH	ARCHITECT, -URAL	EQUIP	EQUIPMENT	MB	MACHINE BOLT	SHTG	SHEATHING
ATR	ALL THREAD ROD	EQUIV	EQUIVALENT	MECH	MECHANICAL	SIM	SIMILAR
AVG	AVERAGE	ES	EACH SIDE	MEZZ	MEZZANINE	SLH	SHORT LEG HORIZONTAL
BC	BOTTOM OF CONCRETE	EST	ESTIMATE	MFR	MANUFACTURE, -ER, -ED	SLV	SHORT LEG VERTICAL
BL	BRICK LEDGE	E-W	EAST TO WEST	MIN	MINIMUM	SOG	SLAB ON GRADE
BLK	BLOCK	EXC	EXCAVATE	ML	MICROLLAM (TRUS-JOIST BRAND LVL)	SP	SPACES, SPACED
BLKG	BLOCKING	EXP	EXPANSION	MO	MASONRY OPENING	SPEC	SPECIFICATIONS
BM	BEAM	EXT	EXTERIOR	MTL	METAL	SQ	SQUARE
BOT	BOTTOM	FD	FLOOR DRAIN	NF	NEAR FACE	ST	SNUG-TIGHT
BRG	BEARING	FDN	FOUNDATION	NIC	NOT IN CONTRACT	STD	STANDARD
BW	BOTTOM OF WALL	FF	FINISHED FLOOR, FAR FACE	NS	NEAR SIDE	STIFF	STIFFENER
CB	COUNTERBORE	F-F	FACE TO FACE	N-S	NORTH TO SOUTH	STL	STEEL
CF	CUBIC FOOT	FIG	FIGURE	NTS	NOT TO SCALE	STRUCT	STRUCTURE, -AL
CG	CENTER OF GRAVITY	FL	FLUSH	OCJ	OSHA COLUMN JOIST	SUPT	SUPPORT
CFS	COLD FORMED STEEL	FLG	FLANGE	OD	OUTSIDE DIAMETER	SY	SQUARE YARD
CIP	CAST-IN-PLACE	FLR	FLOOR	OH	OPPOSITE HAND	SYM	SYMMETRICAL
CJ	CONSTRUCTION JOINT, CONTROL JOINT	FO	FACE OF	OPNG	OPENING	T&B	TOP AND BOTTOM
CJP	COMPLETE JOINT PENETRATION	FP	FULL PENETRATION	OPP	OPPOSITE	T&G	TONGUE AND GROOVE
CL	CENTER LINE	FS	FOOT STEP, FAR SIDE	OSB	ORIENTED STRAND BOARD	TB	TOP OF BEAM
CLG	CEILING	FTG	FOOTING	PAF	POWDER ACTUATED FASTENER	TC	TOP OF CONCRETE
CLR	CLEAR	GA	GAGE, GAUGE	PC	PRECAST	TCA	TORQUE-CONTROLLED ANCHOR
CM	CONSTRUCTION MANAGER -MENT	GALV	GALVANIZED	PCF	POUNDS PER CUBIC FOOT	TD	TOP OF DECK
CMU	CONCRETE MASONRY UNIT	GC	GENERAL CONTRACTOR	PE	PRE-ENGINEERED	THD	THREAD
COL	COLUMN	GEN	GENERAL	PEN	PENETRATION	THK	THICK, -NESS
COM	COMMON	GL	GLUED LAMINATED, GLULAM	PERP	PERPENDICULAR	TJ	TOP OF JOIST
COMB	COMBINATION	GND	GROUND	PJP	PARTIAL JOINT PENETRATION	TL	TOTAL LOAD
CONC	CONCRETE	GR	GRADE	PL	PLATE, PROPERTY LINE	TPG	TOPPING
CONN	CONNECTION	GT	GIRDER TRUSS	PLF	POUND PER LINEAR FOOT	TRANS	TRANSVERSE
CONT	CONTINUOUS, CONTINUE	GYP BD	GYPSUM BOARD	PNL	PANEL	TW	TOP OF WALL
COORD	COORDINATE, COORDINATION	HAS	HEADED ANCHOR STUD	PP	PANEL POINT	TYP	TYPICAL
CS	COUNTERSINK	HDG	HOT-DIP GALVANIZED	PS	PRESTRESSED	ULT	ULTIMATE
CTR	CENTER	HDR	HEADER	PSF	POUNDS PER SQUARE FOOT	UNO	UNLESS NOTED OTHERWISE
CY	CUBIC YARD	HORIZ	HORIZONTAL	PSI	POUNDS PER SQUARE INCH	VERT	VERTICAL
DAB	DEFORMED ANCHOR BAR	HP	HIGH POINT	PSL	PARALLEL STRAND LUMBER (GENERIC TERM)	VIF	VERIFY IN FIELD
DET	DETAIL	HT	HEIGHT	PT	POST TENSIONED PRESSURE TREATED	WP	WORK POINT
DEV	DEVELOP	ID	INSIDE DIAMETER	PTN	PARTITION	WT	WEIGHT
DIAG	DIAGONAL	INT	INTERIOR, INTERMEDIATE	PWD	PLYWOOD	WWF	WELDED WIRE FABRIC
DIM	DIMENSION	IT	INVERTED TEE	QTY	QUANTITY	XS	EXTRA STRONG
DL	DEAD LOAD	JB	JOIST BEARING	R	RADIUS	XSECT	CROSS SECTION
DN	DOWN	JST	JOIST	RE	REFERENCE, REFER TO	XXS	DOUBLE EXTRA STRONG
DP	DRILLED PIER	JT	JOINT	RECT	RECTANGLE		

SYMBOLS KEY

	DIRECTION OF DECK SPAN
GRID	GRID DESIGNATION
X	REVISION
SWx	SHEAR WALL
	SHORING
	STEP IN FLOOR ELEVATION
	CMU (CONCRETE MASONRY UNIT)
	BRICK
	CIP CONCRETE
	PRECAST CONCRETE
	EXISTING CONCRETE
	EARTH
F.X.X	ISOLATED SPREAD FOOTING MARK
F.X.X	SPREAD FOOTING MARK
STEP	STEP IN BOTTOM OF WALL/GRADE BEAM
XX:12	ROOF SLOPE
SLOPE	DIRECTION OF SLOPE (DOWN)
DN UP	STAIR OR RAMP DIRECTION

BUILDING COLUMN DESIGNATIONS

CONT C	COLUMN CONTINUOUS FROM LEVEL BELOW
CXX	COLUMN STARTING AT THIS LEVEL
B	COLUMN STOPPING BELOW THIS LEVEL, SEE FRAMING PLAN AT NEXT LOWER LEVEL
CXX STUB	COLUMN STARTING AND ENDING AT THIS LEVEL OF FRAMING
CXX HGR	COLUMN CONNECTING A LOWER BEAM TO A HIGHER BEAM AT THIS LEVEL OF FRAMING

BRACED/FRAME BAY SYMBOLS

B	INDICATES BRACED BAY MARK
X SX	INDICATES BRACED BAY ELEVATION
	INDICATES CONFIGURATION OF INVERTED CHEVRON-TYPE BRACED BAY WITH HSS DIAGONAL BRACES
	INDICATES CONFIGURATION OF SINGLE DIAGONAL BRACED BAY WITH HSS DIAGONAL BRACE
RF	INDICATES RIGID (MOMENT) FRAME WITH FULL PENETRATION WELDED BEAM FLANGE TO COLUMN CONNECTIONS
X SX	INDICATES RIGID (MOMENT) FRAME ELEVATION W/ FULL PENETRATION WELDED BEAM FLANGE TO COLUMN CONNECTIONS
	INDICATES BRACED BAY OR FRAMED BAY COLUMN BASE
	FULLY WELDED MOMENT CONNECTION
	LOCATION OF BEND IN BENT BEAM
<X>	NUMBER OF HEADED ANCHOR STUDS

STRUCTURAL DRAWING LIST

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SEH Project	17945
Project Manager	AJT
Drawn By	SCR

Project Status	Issue Date
CONSTRUCTION DOCUMENTS	11/09/2017

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1	ADDENDUM NO 1	12/1/17
4	Permit Comments	6/1/2018

COVER SHEET

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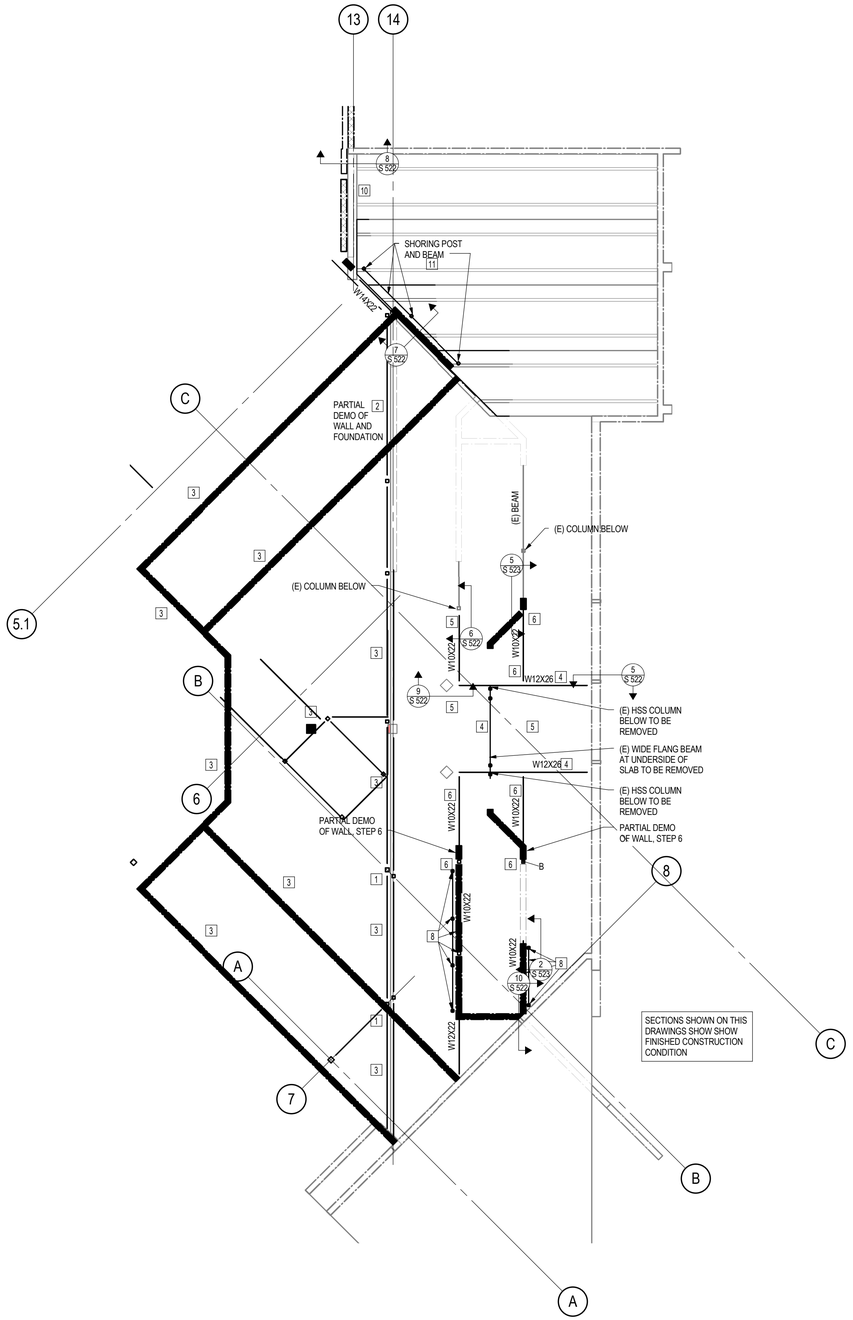
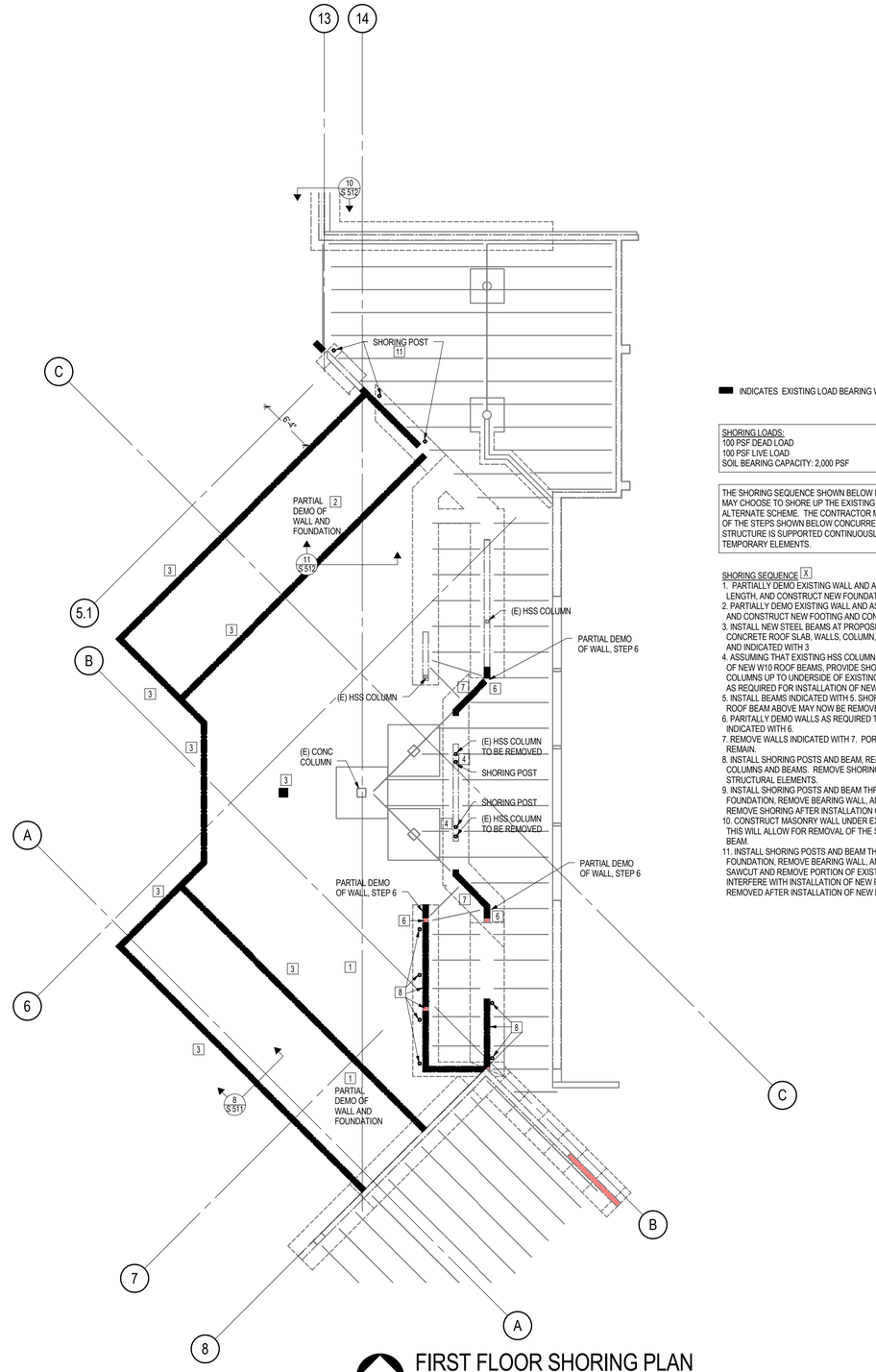


SECOND FLOOR SHORING PLAN

NORTH 1/8" = 1'-0"

0 2' 4' 8' 16'



FIRST FLOOR SHORING PLAN

NORTH 1/8" = 1'-0"

0 2' 4' 8' 16'

▬ INDICATES EXISTING LOAD BEARING WALL TO BE REMOVED

SHORING LOADS:
100 PSF DEAD LOAD
100 PSF LIVE LOAD
SOIL BEARING CAPACITY: 2,000 PSF

THE SHORING SEQUENCE SHOWN BELOW IS OPTIONAL. CONTRACTOR MAY CHOOSE TO SHORE UP THE EXISTING ROOF SLAB WITH AN ALTERNATE SCHEME. THE CONTRACTOR MAY ALSO PERFORM SOME OF THE STEPS SHOWN BELOW CONCURRENTLY AS LONG AS THE ROOF STRUCTURE IS SUPPORTED CONTINUOUSLY BE EITHER PERMANENT OR TEMPORARY ELEMENTS.

SHORING SEQUENCE X

1. PARTIALLY DEMO EXISTING WALL AND ASSOCIATED FOUNDATION, 6'-0 MAX LENGTH, AND CONSTRUCT NEW FOUNDATIONS, PILASTERS, AND STEEL COLUMNS.
2. PARTIALLY DEMO EXISTING WALL AND ASSOCIATED FOUNDATION, 6'-0" MAXLENGTH, AND CONSTRUCT NEW FOOTING AND CONCRETE WALL TO UNDERSIDE OF SLAB.
3. INSTALL NEW STEEL BEAMS AT PROPOSED EDGE, SAWCUT AND REMOVE CONCRETE ROOF SLAB, WALLS, COLUMN, AND FOUNDATIONS WEST OF SAWCUT AND INDICATED WITH 3
4. ASSUMING THAT EXISTING HSS COLUMNS AND ROOF BEAM PROHIBIT INSTALLATION OF NEW W10 ROOF BEAMS, PROVIDE SHORING POSTS INTERNAL TO EXISTING COLUMNS UP TO UNDERSIDE OF EXISTING ROOF BEAM. CUT EXISTING ROOF BEAM AS REQUIRED FOR INSTALLATION OF NEW ROOF BEAMS INDICATED WITH 4
5. INSTALL BEAMS INDICATED WITH 5. SHORING POSTS INSTALLED IN STEP 4 AND ROOF BEAM ABOVE MAY NOW BE REMOVED.
6. PARITALLY DEMO WALLS AS REQUIRED TO INSTALL COLUMNS AND BEAMS INDICATED WITH 6.
7. REMOVE WALLS INDICATED WITH 7. PORTION OF WALL BELOW FLOOR SHALL REMAIN.
8. INSTALL SHORING POSTS AND BEAM, REMOVE BEARING WALL, AND INSTALL NEW COLUMNS AND BEAMS. REMOVE SHORING AFTER INSTALLATION OF PERMANENT STRUCTURAL ELEMENTS.
9. INSTALL SHORING POSTS AND BEAM THROUGH FLOOR SLAB TO BEAR ON FOUNDATION, REMOVE BEARING WALL, AND INSTALL NEW COLUMNS AND BEAMS. REMOVE SHORING AFTER INSTALLATION OF PERMANENT STRUCTURAL ELEMENTS.
10. CONSTRUCT MASONRY WALL UNDER EXISTING CONCRETE BEAM AS SHOWN ON 3/S 521 THIS WILL ALLOW FOR REMOVAL OF THE SUPPORT AT THE SOUTH END OF THE BEAM.
11. INSTALL SHORING POSTS AND BEAM THROUGH FLOOR SLAB TO BEAR ON FOUNDATION, REMOVE BEARING WALL, AND INSTALL NEW ROOF SUPPORT BEAM. SAWCUT AND REMOVE PORTION OF EXISTING CONCRETE BEAM THAT MAY INTERFERE WITH INSTALLATION OF NEW ROOF SUPPORT BEAM. SHORING MAY BE REMOVED AFTER INSTALLATION OF NEW BEAM.

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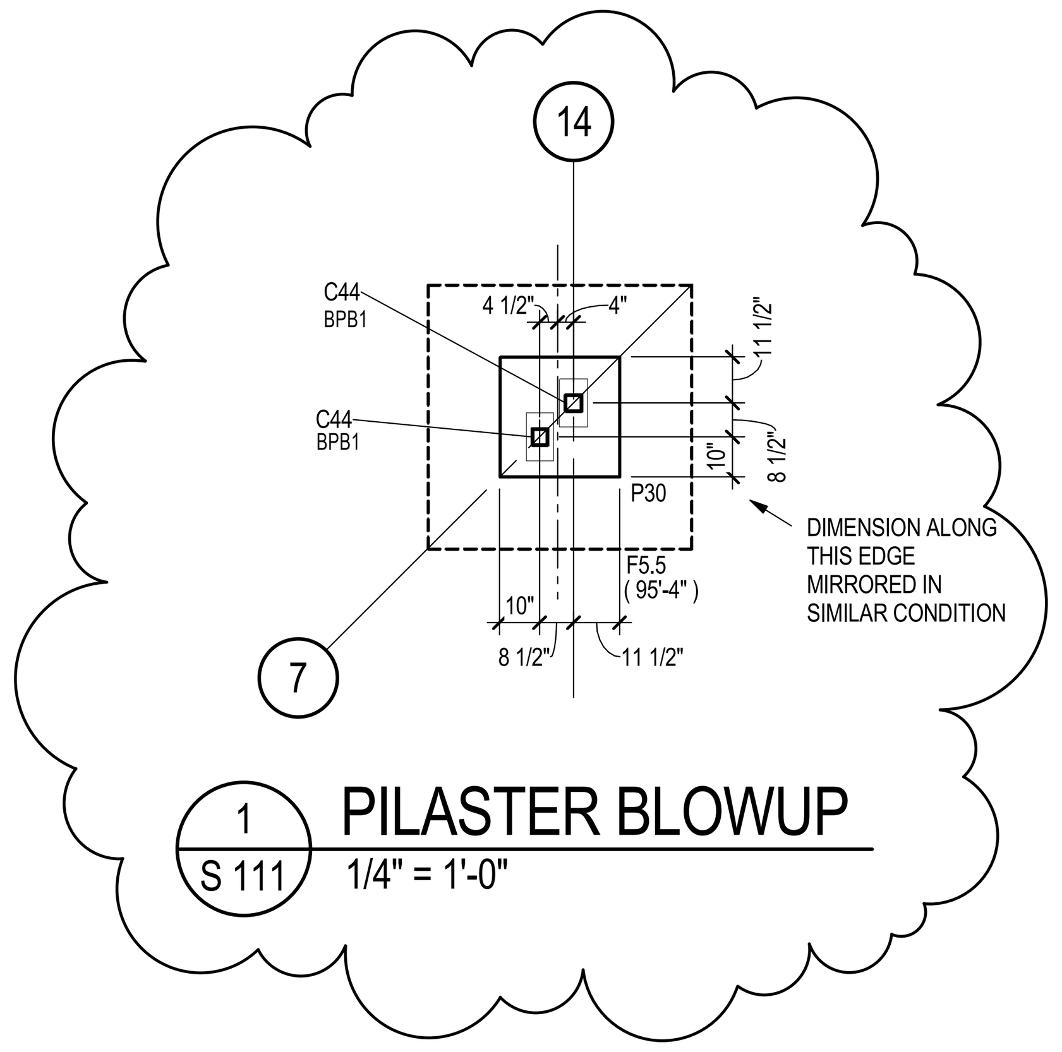
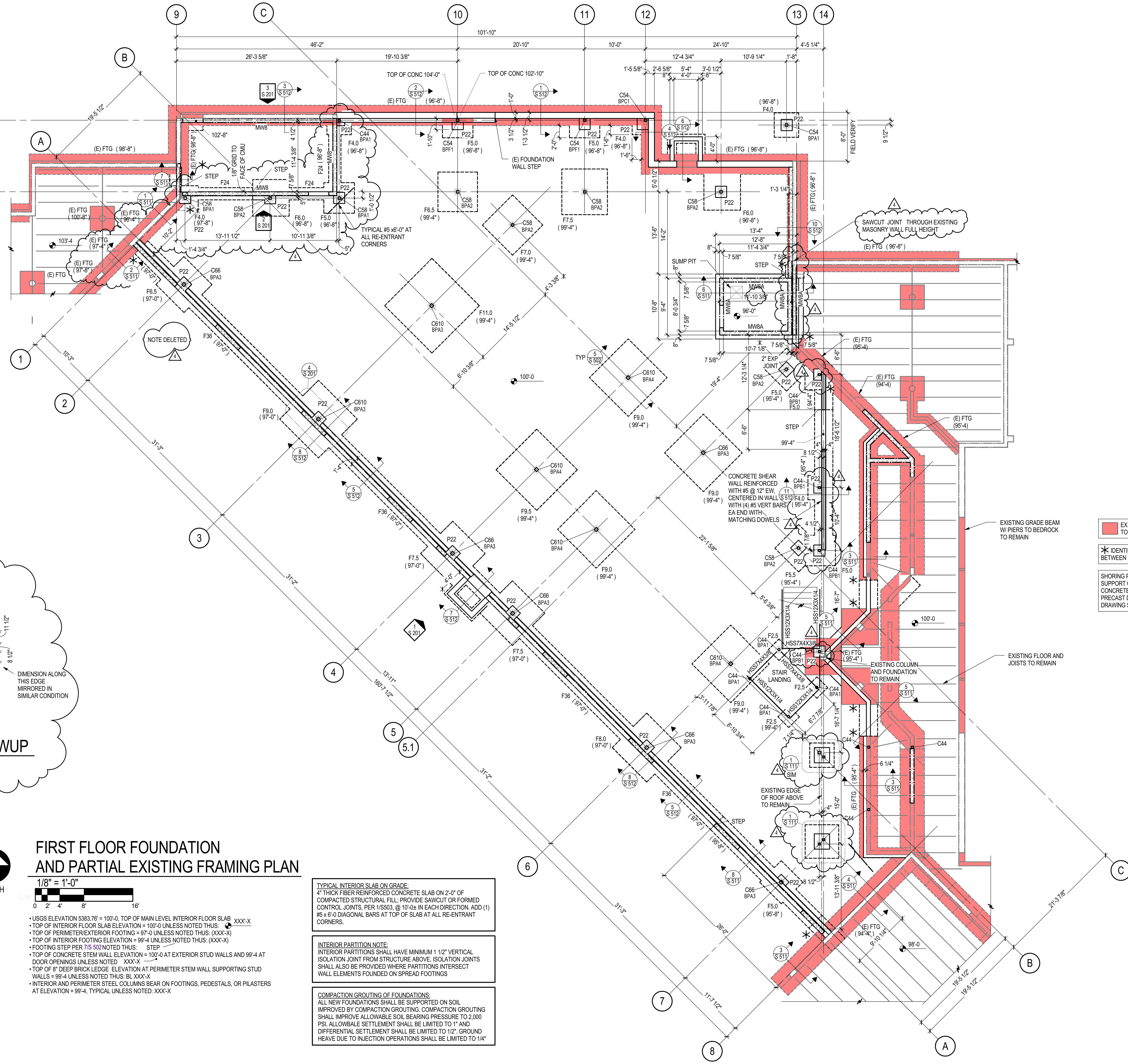
1	ADDENDUM NO 1	12/1/17

SHORING PLAN

S
101





FIRST FLOOR FOUNDATION AND PARTIAL EXISTING FRAMING PLAN

1/8" = 1'-0"

0 2' 4' 8' 16'

NORTH

- USGS ELEVATION 5383.76' = 100'-0, TOP OF MAIN LEVEL INTERIOR FLOOR SLAB XXX'-X
- TOP OF INTERIOR FLOOR SLAB ELEVATION = 100'-0 UNLESS NOTED THUS:
- TOP OF PERIMETER/EXTERIOR FOOTING = 97'-0 UNLESS NOTED THUS: (XXX'-X)
- TOP OF INTERIOR FOOTING ELEVATION = 99'-4 UNLESS NOTED THUS: (XXX'-X)
- FOOTING STEP PER 7/S 502 NOTED THUS: STEP
- TOP OF CONCRETE STEM WALL ELEVATION = 100'-0 AT EXTERIOR STUD WALLS AND 99'-4 AT DOOR OPENINGS UNLESS NOTED XXX'-X
- TOP OF 8" DEEP BRICK LEDGE ELEVATION AT PERIMETER STEM WALL SUPPORTING STUD WALLS = 99'-4 UNLESS NOTED THUS: BL XXX'-X
- INTERIOR AND PERIMETER STEEL COLUMNS BEAR ON FOOTINGS, PEDESTALS, OR PILASTERS AT ELEVATION = 99'-4, TYPICAL UNLESS NOTED: XXX'-X

TYPICAL INTERIOR SLAB ON GRADE:
4" THICK FIBER REINFORCED CONCRETE SLAB ON 2'-0" OF COMPACTED STRUCTURAL FILL; PROVIDE SAWCUT OR FORMED CONTROL JOINTS, PER 1/S503, @ 10'-0± IN EACH DIRECTION. ADD (1) #5 x 6'-0 DIAGONAL BARS AT TOP OF SLAB AT ALL RE-ENTRANT CORNERS.

INTERIOR PARTITION NOTE:
INTERIOR PARTITIONS SHALL HAVE MINIMUM 1 1/2" VERTICAL ISOLATION JOINT FROM STRUCTURE ABOVE. ISOLATION JOINTS SHALL ALSO BE PROVIDED WHERE PARTITIONS INTERSECT WALL ELEMENTS FOUNDED ON SPREAD FOOTINGS

COMPACTION GROUTING OF FOUNDATIONS:
ALL NEW FOUNDATIONS SHALL BE SUPPORTED ON SOIL IMPROVED BY COMPACTION GROUTING. COMPACTION GROUTING SHALL IMPROVE ALLOWABLE SOIL BEARING PRESSURE TO 2,000 PSI. ALLOWBALE SETTLEMENT SHALL BE LIMITED TO 1" AND DIFFERENTIAL SETTLEMENT SHALL BE LIMITED TO 1/2". GROUND HEAVE DUE TO INJECTION OPERATIONS SHALL BE LIMITED TO 1/4"

EXISTING FOUNDATIONS TO REMAIN

* IDENTIFIES DOWELED CONNECTIONS BETWEEN EXISTING AND NEW FOUNDATIONS

SHORING POSTS REQUIRED FOR SUPPORT OF EXISTING 8" CAST-IN-PLACE CONCRETE ROOF AND EXISTING PRECAST DOUBLE-TEE ROOF. REFER TO DRAWING S 101 FOR SHORING PLAN

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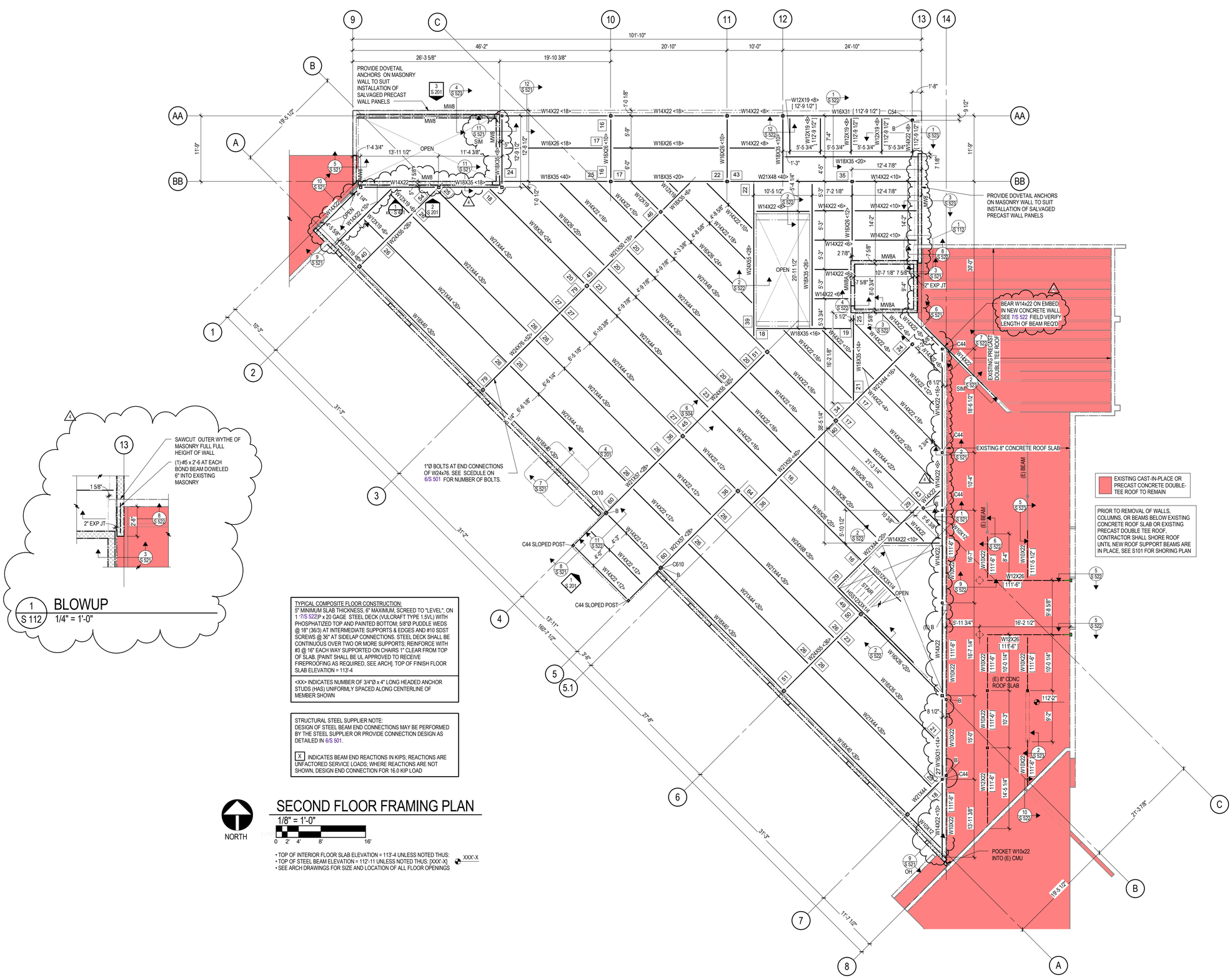
4	Permit Comments	6/1/2018

FIRST FLOOR FOUNDATION AND FRAMING PLAN

S 111



1 S 112 **BLOWUP**
1/4" = 1'-0"

TYPICAL COMPOSITE FLOOR CONSTRUCTION:
5" MINIMUM SLAB THICKNESS, 6" MAXIMUM, SCREED TO "LEVEL", ON 1 7/S 522P x 20 GAGE STEEL DECK (VULCRAFT TYPE 1.5VL) WITH PHOSPHATIZED TOP AND PAINTED BOTTOM, 5/8"Ø PUDDLE WEDS @ 18" (36/3) AT INTERMEDIATE SUPPORTS & EDGES AND #10 SDST SCREWS @ 36" AT SIDELAP CONNECTIONS. STEEL DECK SHALL BE CONTINUOUS OVER TWO OR MORE SUPPORTS; REINFORCE WITH #3 @ 16" EACH WAY SUPPORTED ON CHAIRS 1" CLEAR FROM TOP OF SLAB. [PAINT SHALL BE UL APPROVED TO RECEIVE FIREPROOFING AS REQUIRED, SEE ARCH]. TOP OF FINISH FLOOR SLAB ELEVATION = 113'-4

<XX> INDICATES NUMBER OF 3/4"Ø x 4" LONG HEADED ANCHOR STUDS (HAS) UNIFORMLY SPACED ALONG CENTERLINE OF MEMBER SHOWN

STRUCTURAL STEEL SUPPLIER NOTE:
DESIGN OF STEEL BEAM END CONNECTIONS MAY BE PERFORMED BY THE STEEL SUPPLIER OR PROVIDE CONNECTION DESIGN AS DETAILED IN 6/S 501.

[X] INDICATES BEAM END REACTIONS IN KIPS; REACTIONS ARE UNFACTORED SERVICE LOADS; WHERE REACTIONS ARE NOT SHOWN, DESIGN END CONNECTION FOR 16.0 KIP LOAD

NORTH

SECOND FLOOR FRAMING PLAN
1/8" = 1'-0"
0 2' 4' 8' 16'

- TOP OF INTERIOR FLOOR SLAB ELEVATION = 113'-4 UNLESS NOTED THUS: XXX'-X
- TOP OF STEEL BEAM ELEVATION = 112'-11 UNLESS NOTED THUS: [XXX'-X]
- SEE ARCH DRAWINGS FOR SIZE AND LOCATION OF ALL FLOOR OPENINGS

EXISTING CAST-IN-PLACE OR PRECAST CONCRETE DOUBLE-TEE ROOF TO REMAIN

PRIOR TO REMOVAL OF WALLS, COLUMNS, OR BEAMS BELOW EXISTING CONCRETE ROOF SLAB OR EXISTING PRECAST DOUBLE TEE ROOF, CONTRACTOR SHALL SHORE ROOF UNTIL NEW ROOF SUPPORT BEAMS ARE IN PLACE, SEE S101 FOR SHORING PLAN

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3	RFI #2	3/19/18
4	Permit Comments	6/1/2018
5	RFI #18.1	4/4/18
6	RFI #19	4/5/18

SECOND FLOOR FRAMING PLAN

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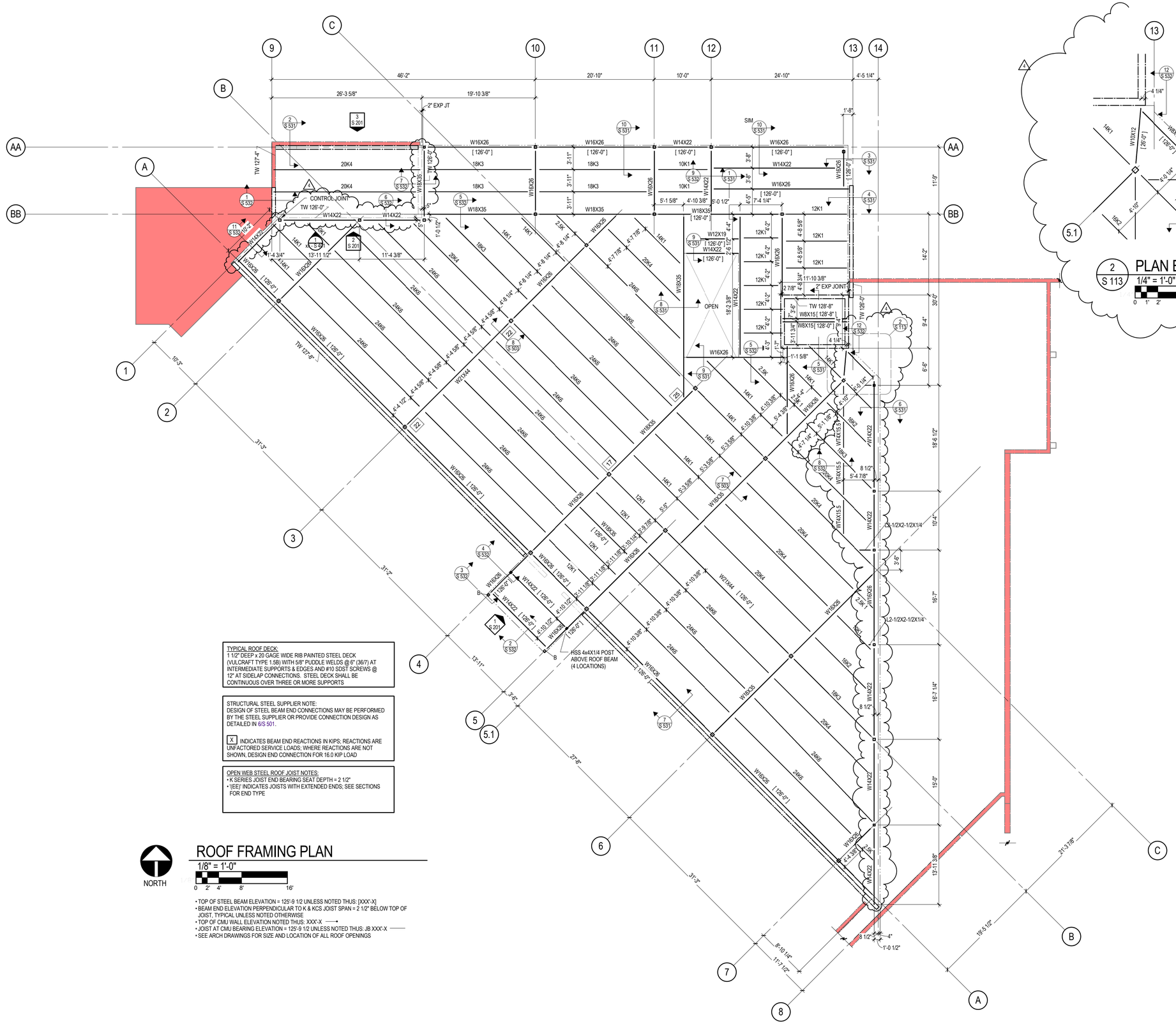

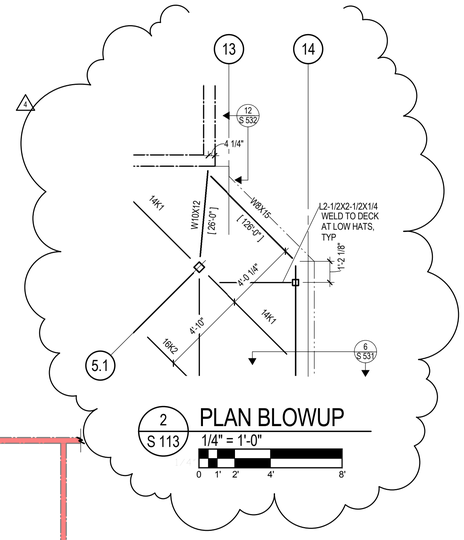

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SEH Project	17945
Project Manager	AJT
Drawn By	SCR
Project Status	Issue Date
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date
1	ADDENDUM NO 1	12/1/17
2	ADDENDUM NO 2	1/16/18
3	RFI #2	3/19/18
4	Permit Comments	6/1/2018

ROOF PLAN

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DUCT LINER / INSULATION SCHEDULE

SYSTEM	INSULATION OR LINER	PHYSICAL DUCT DIMENSIONS LISTED ON DRAWINGS	REMARKS
SUPPLY AIR FROM FAN DISCHARGE TO TERMINAL BOX	EXTERNALLY INSULATED	. .	. .
SUPPLY AIR DOWNSTREAM OF TERMINAL BOX	INTERNALLY LINED	DUCT SIZES LISTED ARE ACTUAL SHEET METAL SIZE AND INCLUDE THICKNESS OF LINER.	. .
RETURN AIR	INTERNALLY LINED	DUCT SIZES LISTED ARE ACTUAL SHEET METAL SIZE AND INCLUDE THICKNESS OF LINER.	. .
EXHAUST AIR	NO INSULATION OR LINER	. .	. .
TRANSFER AIR	INTERNALLY LINED	DUCT SIZES LISTED ARE ACTUAL SHEET METAL SIZE AND INCLUDE THICKNESS OF LINER.	. .

NOTES:

1. REFER TO SPECIFICATIONS FOR THICKNESS OF DUCT LINER AND EXTERIOR INSULATION FOR EACH SYSTEM.

LOAD CALCULATION DESIGN DATA

LOCATION:	BOULDER, COLORADO; 5430 FT. ELEVATION, 40.02547 DEGREES LATITUDE, -105.2731 DEGREES LONGITUDE.	
OUTDOOR CONDITIONS:	SUMMER	= 93 DEGREES F / 60 DEGREES (MEAN COINCIDENT W.B.)
	WINTER	= -10 DEGREES F
INDOOR CONDITIONS:	COOLING	= 75 DEGREES F
	HEATING	= 72 DEGREES F
ENVELOPE CHARACTERISTICS:	GLASS SHADING COEF.:	= (0.33)
	GLASS "U" FACTOR:	= (0.45)
	GLASS LOW-E:	= (Y)
	GLASS INTERIOR SHADING:	= (N)
	WALL INSULATION "R":	= (11.0)
	ROOF INSULATION "R":	= (19.0)
	PERIMETER FOUNDATION WALL INSULATION "R":	= (__)
INTERNAL LOADS:	AVERAGE LIGHTING:	= (2.0) WATTS/S.F.
	AVERAGE MISC. ELECTRICAL:	= (1.5) WATTS/S.F.
	AVERAGE OCCUPANT LOAD:	= (15) S.F./PERSON
OUTDOOR AIR VENTILATION RATE:		= 20 CFM/PERSON
SPECIAL CONDITIONS:		

MECHANICAL LEGEND

ALL SYMBOLS IN LEGEND MAY NOT NECESSARILY BE USED ON THIS PROJECT

ABBREVIATIONS AND DESCRIPTIONS

AFF	ABOVE FINISHED FLOOR
AP	ACCESS PANEL
BOD	BOTTOM OF DUCT
BOP	BOTTOM OF PIPE
C	COMMON
CI	CAST IRON
℄ EL.	CENTER LINE ELEVATION
DIA, D	DIAMETER
EA	EXHAUST AIR
C/S	CORE/SHELL
T/I	TENANT IMPROVEMENT
	POINT OF CONNECTION NEW TO EXISTING
EXISTING	LIGHT LINE WEIGHT FOR EQUIPMENT, PIPING, SYMBOLS, TEXT, ETC. INDICATES EXISTING CONDITIONS WITH NEW WORK SHOWN AS DARK
NEW	
	DASHED INDICATES EXISTING TO BE REMOVED
	DASHED INDICATES EXISTING TO BE REMOVED

FDC	FIRE DEPARTMENT CONNECTION
I.E.	INVERT ELEVATION
MA	MIXED AIR
MD	MOTORIZED DAMPER
MVD	MANUAL VOLUME DAMPER
NC	NORMALLY CLOSED
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
OA	OUTSIDE AIR
A	DIRECTION OF VIEW
	PICTURE DESIGNATION
	DIRECTION OF CUT
	SECTION DESIGNATION
P-3	DRAWN ON THIS SHEET

RA	RETURN AIR
SA	SUPPLY AIR
TCEAD	TEMPERATURE CONTROL EXHAUST AIR DAMPER
TCOAD	TEMPERATURE CONTROL OUTSIDE AIR DAMPER
TCRAD	TEMPERATURE CONTROL RETURN AIR DAMPER
TYP	TYPICAL
UNO	UNLESS NOTED OTHERWISE
VCP	VITRIFIED CLAY PIPE
VTR	VENT THROUGH ROOF
	EQUIPMEN T TYPE
	FLOOR # IF MULTIPLE
	BOX ##__
119-103	
650	CFM
1.2	GPM

(N)	NEW
(E)	EXISTING
(R)	RELOCATED
(F)	FUTURE
M1	WORK NOTE SYMBOL
2	REVISION SYMBOL
	INDICATES SUPPLY AND RETURN PIPING TO UNIT
	HEATING COIL
	TRANSITIONTO SIZE ON PLANS
	CONTROL ENCLOSURE
EQUIPMENT TERMINAL OR VAV BOX	CONTROL/COIL ACCESS

SHEET METAL FITTINGS AND EQUIPMENT

- UNIT HEATER
- BASEBOARD HEATER
- SOUND ATTENUATOR
- EXHAUST FAN ON ROOF
- ROUND 90° CONICAL TAKE OFF FROM RECTANGLE TRUNK
- ROUND DUCT DROP/ RISE IN PLAN
- RECTANGLE DUCT DROP/RISE IN PLAN
- RECTANGULAR 90° TAKEOFF WITH BEVELED TAP
- RECTANGULAR 90° TAKEOFF FROM RECTANGULAR TRUNK
- RECTANGULAR 90° TAKEOFF ON END OF MAIN W/MIN. 12" AIR CUSHION DOWNSTREAM
- VANED ELBOW
- DOUBLE VANED ELBOW
- SUPPLY AIR DIFFUSER
- RETURN OR EXHAUST REGISTER/GRILLE
- UNSHADED AREAS INDICATE DIRECTION OF AIR FLOW (IF NO SHADING, 4-WAY OR ADJUSTABLE)
- LINEAR SLOT DIFFUSER
- BURIED, UNDERFLOOR OR UNDER DUCT
- FLEXIBLE DUCT CONNECTION
- RADIUS ELBOW
- VANED ELBOW
- FLEXIBLE DUCT
- RADIUS ELBOW; 1 DIAMETER
- ROUND 90° CONICAL TAKEOFF FROM RECTANGULAR TRUNK W/ MANUAL VOLUME DAMPER
- ROUND 90° SPIN-IN TAKEOFF FROM RECTANGULAR TRUNK W/MANUAL VOLUME DAMPER
- FIRE/SMOKE DAMPER (# REFERS TO SCHEDULE)
- FIRE DAMPER
- SMOKE DAMPER
- CEILING AIR DEVICE WITH FIRE DAMPER
- ROUND DUCT DOWN (1.5D ELBOW)
- ROUND DUCT UP (1.5D ELBOW)
- RETURN DUCT DOWN (MITERED ELBOW)
- RETURN DUCT UP
- EXHAUST DUCT DOWN (MITERED ELBOW)
- EXHAUST DUCT UP
- TRANSFER DUCT & GRILLES
- DOOR UNDERCUT
- AIR FLOW - SUPPLY
- AIR FLOW - RETURN OR EXHAUST
- AIR FLOW DIRECTION
- ACCESS PANEL
- MANUAL VOLUME DAMPER
- MOTORIZED DAMPER MOTOR
- BACK DRAFT DAMPER
- SUPPLY DUCT DOWN (MITERED ELBOW)
- SUPPLY DUCT UP
- BEVELED TAP OFF OF TOP
- ROUND DUCT TAKE OFF FROM TOP OF DUCT
- DUCT TRANSITION CONCENTRIC
- DUCT TRANSITION ECCENTRIC
- SIDE TAKEOFF AT REGISTER OR GRILLE
- BOTTOM TAKEOFF AT DIFFUSER. PROVIDE TYPICAL PROJECT BALANCING
- SIDE TAKEOFF AT DIFFUSER

PIPING DESIGNATIONS, FITTINGS AND EQUIPMENT

- HWS — HEATING WATER SUPPLY
- HWR — HEATING WATER RETURN
- HRS — HEAT RECOVERY SUPPLY
- HRR — HEAT RECOVERY RETURN
- CWS — CHILLED WATER SUPPLY
- CWR — CHILLED WATER RETURN
- IN-LINE PUMP
- BASE MOUNTED PUMP
- PIPE CONNECTION
- ELBOW UP
- ELBOW DOWN
- TEE UP
- TEE DOWN
- RISE OR DROP
- BRANCH-TOP CONNECTION
- BRANCH-BOTTOM CONNECTION
- PIPE CAP OR PLUG
- UNION
- EXPANSION JOINT
- PIPE ANCHOR
- PIPE ALIGNMENT GUIDE
- FLEXIBLE CONNECTION
- CS — CONDENSER WATER SUPPLY
- CR — CONDENSER WATER RETURN
- CDW — CONDENSER WATER (COMMON)
- LPS — LOW PRESSURE STEAM
- LPR — LOW PRESSURE STEAM (CONDENSATE) RETURN
- PWS — PRE-COOLING WATER SUPPLY
- PWR — PRE-COOLING WATER RETURN
- G — GAS
- STRAINER
- STRAINER W/BLOWOFF VALVE
- 2-WAY VALVE
- STEAM TRAP
- TEMPERATURE GAUGE
- PRESSURE/TEMPERATURE TAP
- WELL
- PRESSURE INDEPENDENT VALVE
- GAS PRESSURE REGULATOR
- GAS COCK
- VENTURI
- MPS — MEDIUM PRESSURE STEAM
- MPR — MEDIUM PRESSURE STEAM (CONDENSATE) RETURN
- HPS — HIGH PRESSURE STEAM
- HPR — HIGH PRESSURE STEAM (CONDENSATE) RETURN
- RL — REFRIGERANT LIQUID
- RS — REFRIGERANT SUCTION
- RHG — REFRIGERANT HOT GAS
- BALL VALVE
- CALIBRATED BALANCE VALVE
- PLUG VALVE
- NEEDLE VALVE
- SOLENOID VALVE
- PRESSURE REDUCING VALVE
- 2-WAY CONTROL VALVE
- 3-WAY CONTROL VALVE
- CHECK VALVE
- GLOBE VALVE
- BUTTERFLY VALVE
- BALANCING VALVE
- CIRCUIT SETTER
- CD — CONDENSATE DRAIN
- NP — NON-POTABLE WATER
- CW — POTABLE (COLD) WATER
- SCW — SOFT COLD WATER
- ARROW PARALLEL TO LINE INDICATES PITCH
- ARROW IN LINE INDICATES DIRECTION OF FLOW
- HOSE END BALL VALVE W/ CAP
- TEMPERATURE/PRESSURE RELIEF VALVE
- VACUUM BREAKER
- AUTOMATIC AIR VENT
- MANUAL AIR VENT
- METER
- PRESSURE GAUGE W/ COCK
- GAUGE W/ PIGTAIL

CONTROLS DEVICES

- FS — FLOW SWITCH
- FT — FLOW TRANSMITTER
- H — HUMIDITY SENSOR
- P — PRESSURE SENSOR
- PDS — PRESSURE DIFFERENTIAL SWITCH
- PDT — PRESSURE DIFFERENTIAL TRANSMITTER
- PI — POSITION INDICATOR
- PSH — PRESSURE SWITCH HIGH
- PSL — PRESSURE SWITCH LOW
- T — TEMPERATURE SENSOR
- TSH — TEMPERATURE SWITCH HIGH
- TSL — TEMPERATURE SWITCH LOW
- S — SENSOR
- SP — STATIC PRESSURE SENSOR
- AIR FLOW DIRECTION ARROW
- H — HUMIDIFIER
- PARALLEL BLADE DAMPER
- OPPOSED BLADE DAMPER
- CS — CURRENT SENSOR
- DM — DAMPER ACTUATOR
- MS — MOTOR STARTER
- VFD — VARIABLE FREQUENCY DRIVE
- H — HORN
- S — DUCT SMOKE DETECTOR
- FS — FLOW SWITCH
- PS — PRESSURE SWITCH
- PI — PRESSURE INDICATOR
- T — AQUASTAT
- MANUAL SWITCH
- WALL MOUNTED THERMOSTAT N - INDICATES NIGHT S - INDICATES SENSOR
- UNIT MOUNTED THERMOSTAT
- H — HUMIDISTAT
- CO — CARBON MONOXIDE
- CO2 — CARBON DIOXIDE
- INDICATOR LIGHT

MECHANICAL DRAWING LIST

MECHANICAL GENERAL NOTES

1. DRAWINGS AND SPECIFICATIONS ARE COMPLIMENTARY. WHATEVER IS CALLED FOR IN EITHER IS BINDING AS THOUGH CALLED FOR IN BOTH.
2. THIS PROJECT HAS BEEN COMPLETED IN REVIT. THIS CONTRACTOR SHALL REVIEW THE MODEL CREATED BY THE ARCHITECT / ENGINEER THAT ILLUSTRATES THE DESIGN INTENT OF THE PROJECT. THIS MODEL IS NOT INTENDED TO BE USED AS A SHOP DRAWING, BUT IS A TOOL TO ENABLE THE CONTRACTOR TO BE ABLE TO CREATE FABRICATION DRAWINGS AND COORDINATE THE INSTALLATION OF THE WORK DESCRIBED IN THESE DOCUMENTS.
3. DUCT AND PIPE SIZE DIMENSIONS ARE IN INCHES UNLESS NOTED OTHERWISE.
4. THE EQUIPMENT SPECIFIED ON THE DRAWINGS HAVE BEEN SELECTED AS THE BASIS OF DESIGN. THE USE OF REVIEWED OR SPECIFIED EQUALS SHALL BE COORDINATED BY THE CONTRACTOR AS TO SPACE REQUIREMENTS, EQUIPMENT DIMENSIONS AND PERFORMANCE. ANY ADDITIONAL COSTS EITHER DIRECTLY OR INDIRECTLY CAUSED BY EQUALS SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.
5. COORDINATE ALL DIFFUSER AND GRILLE LOCATIONS WITH ARCHITECTURAL REFLECTED CEILING PLAN, FIRE PROTECTION, AND ELECTRICAL DRAWINGS.
6. DRAWINGS ARE DIAGRAMMATIC AND SHOW THE GENERAL DESIGN INTENT, ARRANGEMENT AND EXTENT OF SYSTEMS. DO NOT SCALE DRAWINGS NOR USE AS SHOP DRAWINGS. WHERE ALTERNATE ROUTING, OFFSETS AND TRANSITIONS ARE REQUIRED FOR FIELD COORDINATION OF ALL TRADES, THIS CONTRACTOR SHALL MAKE CHANGES WITHOUT ADDITIONAL COSTS.
7. CONTRACTOR SHALL NOT SHUT-OFF/PUT OUT OF SERVICE ANY SYSTEMS/SERVICES WITHOUT FIRST COORDINATING ALL DOWNTIME WITH OWNER'S PERSONNEL. CONTRACTOR SHALL PROVIDE A DETAILED M.O.P. AS REQUIRED. DO NOT BEGIN WORK WITHOUT WRITTEN APPROVAL.
8. ALL EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS UNLESS SPECIFICALLY DIRECTED OTHERWISE.
9. CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATION AND INSTALLING SLEEVES, INSERTS AND SUPPORTS AS REQUIRED FOR THIS SCOPE OF WORK AND/OR CORE DRILL REQUIREMENTS. COORDINATE WITH GENERAL CONTRACTOR AND STRUCTURAL ENGINEER AS REQUIRED.
10. CONTRACTOR SHALL CLOSELY COORDINATE NEW MECHANICAL WITH ALL NEW AND EXISTING MECHANICAL, PLUMBING, ELECTRICAL, FIRE PROTECTION, ARCHITECTURAL AND STRUCTURAL MEMBERS. REFER TO DIVISION 23 SPECIFICATIONS FOR CEILING SPACE ALLOCATION PRIORITIES.
11. CONTRACTOR SHALL FIELD VERIFY ALL MECHANICAL ITEMS PRIOR TO SUBMITTING A BID. NO ADDITIONAL COST WILL BE ALLOWED FOR CONTRACTOR'S FAILURE TO BECOME FAMILIAR WITH ALL EXISTING CONDITIONS.
12. ALL MECHANICAL SYSTEMS SHALL BE INSTALLED IN ACCORDANCE WITH THE 2012 INTERNATIONAL BUILDING CODE, 2012 INTERNATIONAL FIRE CODE OR NFPA, 2012 INTERNATIONAL MECHANICAL CODE, AND 2012 INTERNATIONAL PLUMBING CODE AND 2012 INTERNATIONAL ENERGY CONSERVATION CODE; INCLUDING BOULDER AMENDMENTS. REFER TO ARCHITECTURAL CODE PLAN.
13. CONTRACTOR SHALL PROVIDE SUBMITTALS ON ITEMS LISTED IN THE MECHANICAL SCHEDULES AND AS REQUIRED IN EACH SECTION OF SPECIFICATION TO THE ENGINEER/OWNER FOR REVIEW PRIOR TO THE ORDER, PURCHASE OR INSTALLATION OF THESE SAME ITEMS.
14. ALL EXISTING EQUIPMENT TO BE REMOVED SHALL HAVE ALL RELATED HOUSEKEEPING PADS, PIPING, CONTROLS, GAUGES, ELECTRICAL SERVICE, HANGERS, SUPPORTS AND ANY MISCELLANEOUS RELATED SERVICE OR PARTS REMOVED COMPLETELY.
15. PROVIDE MANUAL AIR VENTS ON CLOSED SYSTEM WATER PIPING AT ALL CHANGES IN ELEVATION DOWNWARD IN DIRECTION OF WATER FLOW.
16. CONTRACTOR SHALL CONSTRUCT AND INSTALL DUCTWORK ACCORDING TO SMACNA STANDARDS AS A MINIMUM REQUIREMENT. REFER TO SPECIFICATIONS FOR ADDITIONAL INFORMATION.
17. ALL DUCT DIMENSIONS ARE OUTSIDE DIMENSIONS. WHERE DUCT LINER IS USED, THE THICKNESS OF THE LINER TO MAINTAIN THE CLEAR INSIDE DIMENSION HAS BEEN INCLUDED. REFER TO DUCT INSULATION / LINER SCHEDULE AND/OR DIVISION 23 OF THE SPECIFICATIONS.
18. SPIN-IN FITTINGS TO VAV BOXES AND DIFFUSERS SHALL BE CONICAL TYPE (EXCEPT LOCATIONS WHERE LISTED DUCT HEIGHT DOES NOT ACCOMMODATE). SPIN-IN FITTINGS TO DIFFUSERS SHALL INCLUDE AN INTEGRAL MANUAL VOLUME DAMPER.
19. RIGID INLET DUCTS TO VAV BOXES [AND OUTLET DUCTS FOR EXHAUST TERMINALS] SHALL BE THE SAME SIZE AS THE VAV BOX INLET CONNECTION UNLESS NOTED OTHERWISE FOR A MINIMUM OF THREE DIAMETERS OF STRAIGHT DUCT.
20. ALL OPENINGS FROM EXHAUST DUCTS, EXHAUST FANS, GRAVITY ROOF VENTS, INTAKE LOUVERS AND GOOSENECKS SHALL BE A MINIMUM OF 12" ABOVE THE TOP OF THE FINISHED ROOFING SURFACE.
21. MOUNT THERMOSTAT AT 48" ON CENTER ABOVE FINISHED FLOOR UNLESS OTHERWISE NOTED. ADA REQUIREMENT.
22. PROVIDE REDLINE MARK-UPS FOR ANY FIELD CHANGES OR MODIFICATIONS ON THE CONSTRUCTION DOCUMENTS. REDLINE DRAWINGS SHALL BE PROVIDED WHETHER COORDINATION DRAWINGS ARE REQUIRED OR NOT.
23. EQUIPMENT E.E.R. AND/OR C.O.P. VALUES SHALL COMPLY WITH THE CURRENT EDITION OF ASHRAE 90.1.
24. EXISTING EQUIPMENT AS NOTED ON THE DRAWINGS SHALL BE RETURNED TO THE OWNER AT THEIR DESIGNATED LOCATION.
25. PRIOR TO BALANCING MECHANICAL CONTRACTOR SHALL PROVIDE A CLEAN SET OF FILTERS FOR AIR HANDLING UNITS. THIS CONTRACTOR SHALL PROVIDE A MEANS TO SIMULATE 50% LOADED FILTERS. SYSTEM SHALL BE BALANCED IN THIS MODE.
26. CONVENTIONS USED IN THE PRESENTATION OF THE CONTRACT DOCUMENTS:
    - A. CFM IS AT ALTITUDE OF PROJECT.
    - B. STATIC PRESSURES AND AIR PRESSURE DROPS ARE AT SEA LEVEL.
    - C. HEATING AND COOLING CAPACITIES ARE AT ALTITUDE OF PROJECT.
    - D. HORSEPOWERS ARE CORRECTED FOR ALTITUDE.
    - E. NATURAL GAS INPUTS ARE AT SEA LEVEL.

MECHANICAL NARRATIVE

THIS MECHANICAL PROJECT WILL ADD HEATING AND COOLING CONDITIONED AIR TO THE NEW DA INFILL. EXISTING AIR HANDLERS' DISTRIBUTION DUCTWORK WILL BE MODIFIED AT THE ROOF AND DISTRIBUTED TO THE ASSOCIATED FLOORS BELOW. RTU-1 WILL SERVE FIRST AND SECOND LEVELS IN THE NORTHWEST CORNER OF THE INFILL. RTU-2 WILL SERVE FIRST AND SECOND LEVELS IN THE SOUTHEAST CORNER OF THE INFILL. CONNECT NEW PIPING TO PIPING CONSTRUCTED IN THE MEP RE-ROUTE PACKAGE PORTION OF THIS PROJECT.

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JUSTICE CENTER DA INFILL

1777 6th St.
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SEH Project	135948
Project Manager	JDA
Drawn By	JDA
Project Status	**Issue Date**
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date

MECHANICAL GENERAL INFORMATION

M 000

TERMINAL BOX SCHEDULE

PLAN CODE	DESIGN MFR.	DESIGN MODEL	INSTALLED MFR.	INSTALLED MODEL	INLET SIZE (IN.) DIA.	W	H	AIRFLOW SETPOINTS COOLING MAX (CFM)	AIRFLOW MIN (CFM)	HEATING MAX (CFM)	MAXIMUM AIR PRESSURE DROP (IN. W.C.)	MAX DISCHARGE N.C.	HEATING COIL DATA EAT (°F)	LAT (°F)	EWT (°F)	LWT (°F)	COIL MBH	GLYCOL %	GPM	MAX WATER P.D. (FT. W.C.)	REMARKS
TB-0-1	PRICE	SDV			12			1200	1200	1200	1.00 in-wg	30	55	85	180	150	32.4	0	2.2	1.00 psi	(1) (2) (3) (4)
TB-1-1	PRICE	SDV			6			200	60	110	1.00 in-wg	30	55	85	180	160	3.0	0	0.3	1.00 psi	(1) (2) (3) (4)
TB-1-2	PRICE	SDV			6			200	60	110	1.00 in-wg	30	55	85	180	160	3.0	0	0.3	1.00 psi	(1) (2) (3) (4)
TB-1-3	PRICE	SDV			6			200	60	110	1.00 in-wg	30	55	85	180	160	3.0	0	0.3	1.00 psi	(1) (2) (3) (4)
TB-1-4	PRICE	SDV			6			200	60	110	1.00 in-wg	30	55	85	180	160	3.0	0	0.3	1.00 psi	(1) (2) (3) (4)
TB-1-5	PRICE	SDV			6			250	60	120	1.00 in-wg	30	55	85	180	160	3.2	0	0.3	1.00 psi	(1) (2) (3) (4)
TB-1-6	PRICE	SDV			6			400	150	300	1.00 in-wg	30	55	85	180	160	8.1	0	0.8	1.00 psi	(1) (2) (3) (4)
TB-1-7	PRICE	SDV			6			300	90	180	1.00 in-wg	30	55	85	180	160	4.9	0	0.5	1.00 psi	(1) (2) (3) (4)
TB-1-8	PRICE	SDV			8			600	150	300	1.00 in-wg	30	55	85	180	160	8.1	0	0.8	1.00 psi	(1) (2) (3) (4)
TB-1-9	PRICE	SDV			6			500	75	150	1.00 in-wg	30	55	85	180	160	4.1	0	0.4	1.00 psi	(1) (2) (3) (4)
TB-1-10	PRICE	SDV			10			1200	270	540	1.00 in-wg	30	55	85	180	160	14.6	0	1.5	1.00 psi	(1) (2) (3) (4)
TB-1-11	PRICE	SDV			6			500	75	150	1.00 in-wg	30	55	85	180	160	4.1	0	0.4	1.00 psi	(1) (2) (3) (4)
TB-1-12	PRICE	SDV			6			500	75	150	1.00 in-wg	30	55	85	180	160	4.1	0	0.4	1.00 psi	(1) (2) (3) (4)
TB-1-13	PRICE	SDV			6			250	40	100	1.00 in-wg	30	55	85	180	160	2.7	0	0.3	1.00 psi	(1) (2) (3) (4)
TB-1-14	PRICE	SDV			6			200	60	120	1.00 in-wg	30	55	85	180	160	3.2	0	0.3	1.00 psi	(1) (2) (3) (4)
TB-1-15	PRICE	SDV			6			280	85	160	1.00 in-wg	30	55	85	180	160	4.3	0	0.4	1.00 psi	(1) (2) (3) (4)
TB-1-16	PRICE	SDV			8			600	180	360	1.00 in-wg	30	55	85	180	160	9.7	0	1.0	1.00 psi	(1) (2) (3) (4)
TB-1-17	PRICE	SDV			10			2100	540	1080	1.00 in-wg	30	55	85	180	160	29.2	0	2.9	1.00 psi	(1) (2) (3) (4)
TB-1-18	PRICE	SDV			8			750	115	225	1.00 in-wg	30	55	85	180	160	6.1	0	0.6	1.00 psi	(1) (2) (3) (4)
TB-1-19	PRICE	SDV			10			450	60	120	1.00 in-wg	30	55	85	180	160	3.2	0	0.3	1.00 psi	(1) (2) (3) (4)
TB-1-20	PRICE	SDV			6			500	75	150	1.00 in-wg	30	55	85	180	160	4.1	0	0.4	1.00 psi	(1) (2) (3) (4)
TB-1-21	PRICE	SDV			6			500	75	150	1.00 in-wg	30	55	85	180	160	4.1	0	0.4	1.00 psi	(1) (2) (3) (4)
TB-1-22	PRICE	SDV			8			250	60	120	1.00 in-wg	30	55	85	180	160	3.2	0	0.3	1.00 psi	(1) (2) (3) (4)
TB-2-1	PRICE	SDV			6			400	75	150	1.00 in-wg	30	55	85	180	160	4.1	0	0.4	1.00 psi	(1) (2) (3) (4)
TB-2-2	PRICE	SDV			6			400	120	240	1.00 in-wg	30	55	85	180	160	6.5	0	0.6	1.00 psi	(1) (2) (3) (4)
TB-2-3	PRICE	SDV			6			600	110	220	1.00 in-wg	30	55	85	180	160	5.9	0	0.6	1.00 psi	(1) (2) (3) (4)
TB-2-4	PRICE	SDV			8			750	225	450	1.00 in-wg	30	55	85	180	160	12.2	0	1.2	1.00 psi	(1) (2) (3) (4)
TB-2-5	PRICE	SDV			14			1200	360	720	1.00 in-wg	30	55	85	180	150	19.4	0	1.3	1.00 psi	(1) (2) (3) (4)
TB-2-6	PRICE	SDV			8			450	60	120	1.00 in-wg	30	55	85	180	160	3.2	0	0.3	1.00 psi	(1) (2) (3) (4)
TB-2-7	PRICE	SDV			8			250	40	750	1.00 in-wg	30	55	85	180	160	20.3	0	2.0	1.00 psi	(1) (2) (3) (4)
TB-2-8	PRICE	SDV			8			500	80	160	1.00 in-wg	30	55	85	180	160	4.3	0	0.4	1.00 psi	(1) (2) (3) (4)
TB-2-9	PRICE	SDV			8			250	40	80	1.00 in-wg	30	55	85	180	160	2.2	0	0.2	1.00 psi	(1) (2) (3) (4)
TB-2-10	PRICE	SDV			8			0	210	420	1.00 in-wg	30	55	85	180	160	11.3	0	1.1	1.00 psi	(1) (2) (3) (4)
TB-2-11	PRICE	SDV			8			850	255	510	1.00 in-wg	30	55	85	180	160	13.8	0	1.4	1.00 psi	(1) (2) (3) (4)
TB-2-12	PRICE	SDV			8			600	180	360	1.00 in-wg	30	55	85	180	160	9.7	0	1.0	1.00 psi	(1) (2) (3) (4)
TB-2-13	PRICE	SDV			14			1200	360	720	1.00 in-wg	30	55	85	180	150	19.4	0	1.3	1.00 psi	(1) (2) (3) (4)
TB-2-14	PRICE	SDV			8			500	80	160	1.00 in-wg	30	55	85	180	160	4.3	0	0.4	1.00 psi	(1) (2) (3) (4)
TB-2-15	PRICE	SDV			8			500	80	160	1.00 in-wg	30	55	85	180	160	4.3	0	0.4	1.00 psi	(1) (2) (3) (4)
TB-2-16	PRICE	SDV			8			500	80	160	1.00 in-wg	30	55	85	180	160	4.3	0	0.4	1.00 psi	(1) (2) (3) (4)

(1) PERFORMANCE DATA IS CALCULATED BASED ON THE MIN HEAT REQUIRED TO HEAT THE PRIMARY AIR AND SPACE. ACTUAL SUPPLY AIR TEMPERATURE, LEAVING AIR TEMPERATURE, AND GPM MUST NOT BE LESS THAN SHOWN.

(2) THE HEATING COIL IS LOCATED AT THE DISCHARGE OF THE BOX. THE MIXED AIR TEMPERATURE IS A COMBINATION OF RETURN AIR AND PRIMARY AIR PRIOR TO ENTERING THE HEATING COIL.

(3) PROVIDE EACH BOX WITH CONTROLS TO MATCH THE MAINTENANCE ACCESS LOCATION INDICATED ON THE DRAWING. CONTRACTOR TO COORDINATE WITH ALL OTHER TRADES.

(4) CONTRACTOR TO FIELD VERIFY LEFT OR RIGHT HAND COIL CONNECTION.

GRILLES, REGISTERS AND DIFFUSERS SCHEDULE

PLAN CODE	DESIGN MFR.	DESIGN MODEL	INSTALLED MFR.	INSTALLED MODEL	TYPE	FRAME	MATERIAL	FINISH	DAMPER TYPE	LEGEND	REMARKS
RG	PRICE				EGGCRATE RETURN	LAY-IN	STEEL	OFF-WHITE	N/A	SEE PLANS FOR SIZE	
SD	PRICE	SMD			STEEL MODULAR DIRECTIONAL DIFFUSER	LAY-IN	STEEL	OFF-WHITE	N/A	SEE PLANS FOR SIZE	
SG-1	PRICE	272RL			SIDE WALL GRILLE	SURFACE MOUNTED		OFF-WHITE	N/A	SEE PLANS FOR SIZE	

FAN SCHEDULE

PLAN CODE	DESIGN MFR.	DESIGN MODEL	INSTALLED MFR.	INSTALLED MODEL	SYSTEM	FAN TYPE	CFM @ ALT.	S.P. @ S.L.	WHEEL DIAMETER (INCHES)	FAN RPM (APPROX.)	DRIVE TYPE	H.P.	B.H.P.	DAMPER TYPE	DAMPER SIZE	ELECTRICAL VOLT.	ELECTRICAL PH.	APPROX. WEIGHT (LBS.)	REMARKS
EF-2017-1	GREENHECK	G-123-A			GEN. EXH.	DOWNBLAST CENT.	1500	0.50 in-wg	13	1725	DIRECT	0.3				120 V	1	150	(1) (2) (3) (4)

(1) PROVIDE UNIT MOUNTED SPEED CONTROL SWITCH.

(2) UNIT PRESSURE DROPS SHALL BE ADJUSTED BY MANUFACTURER DURING SHOP DRAWING PHASE.

(3) MOTOR HORSEPOWER ADJUSTMENTS TO INCLUDE REVISIONS NEEDED FOR UNIT DELTA P ADJUSTMENTS, COST OF INCREASE TO BE BORNE BY MANUFACTURER.

(4) PROVIDE CONTROL AT B.A.S.

FAN COIL SPLIT SYSTEM SCHEDULE

PLAN CODE	DESIGN MFR.	DESIGN MODEL	INSTALLED MFR.	INSTALLED MODEL	ARRANGEMENT	CFM @ ALT.	ESP IN. WC @ SL	FAN HP	SERVICE	EAT °F DB	EAT °F WB	LAT °F DB	LAT °F WB	MBH SENS.	MBH TOTAL	EWT (°F)	LWT (°F)	REFRIG. TYPE	REFRIG. CHARGE (LBS.)	SEER	MINIMUM CIRC. AMPACITY	ELEC. VOLT/PH	REMARKS
FCU-17-1	DAIKIN	FTXS30LVJU			WALL MOUNT	700	0.125	-	HEATING	-	-	-	-	-	-	-	-	R410A	6.2	19.3	19.5	208/1	(1),(2),(3),(5)
									COOLING	90		-	50	24.6	30.0	-	-						

(1) INCLUDE WATER SENSOR (SAFE-T-SWITCH OR SIMILAR) TO SHUT UNIT DOWN UPON PRIMARY DRAIN BLOCKAGE.

(2) PROVIDE A MATCHED REMOTE OUTDOOR MOUNTED AIR-COOLED CONDENSER UNIT (ACCU-17-1); DAIKIN #RKS30LVJU, 208-230/1 PHASE, 19.5 MCA, 20 AMP MOP, 13.5 RLA, 180 LBS WEIGHT, 68 Dba, 30,000 BTU/HR CAPACITY, W/MINUS 40 DEGREE FAHRENHEIT AMBIENT OPERATING CAPABILITY.

(3) PROVIDE FIELD WIRING TO FACTORY PROVIDED DISCONNECT AT ACCU. POWER FROM CONTROLS AT UNIT TO REMOTE FCU SHALL BE FIELD WIRED INCLUDING SPACE THERMOSTAT.

(4) PROVIDE CONDENSATE PUMP AND LEVEL CONTROL; POWER CONNECTION IS SEPARATE FROM ACCU/FCU CONNECTION.

CABINET HEATER SCHEDULE (ELECTRIC)

PLAN CODE	MFR.	MODEL	INSTALLED MFR.	INSTALLED MODEL	ARRANGEMENT	CFM @ ALT.	RECESS DEPTH	KW	EAT (°F)	LAT (°F)	MAX. F.L.A.	ELEC. VOLT/PH.	REMARKS
ECUH-1	BERKO	FRA1812F			RECESSED	100	3-3/4"	18	30	712.4	15	480/3	
													(1) (2) (3)

REMARKS:
(1) PROVIDE UNIT MOUNTED LINE VOLTAGE THERMOSTAT.

(2) PROVIDE W/ DISCONNECT.

(3) PROVIDE W/ WALL COLLAR FOR RECESS MOUNTING.

VENTILATION REQUIREMENTS

2015 IMC CALCULATION

Room Number	Number of People	Percent Outside Air	Room Square Footage	Effectiveness	OSA Required	SA CFM Required	SA CFM Designed
CONFERENCE	5	20	150	0.80	34	213	
CONFERENCE	15	20	422	0.80	100	627	
1ST LEVEL OPEN	16	20	5,400	0.80	404	2,525	
2ND LEVEL OPEN	5	20	1,930	0.80	141	880	

Calculation: # of People x 5 = A
Room sqft x 0.06 = B
SA CFM Required = (A+B) /Effectiveness/ % OA in Decimal form
"Number of People" may be based on a chair/people count in accordance with 2009 IMC Section 403.3 exception.
Effectiveness of 0.8 is used for heated and cooled supply air from ceiling diffusers.
Space setpoint 72 degrees. Cooling supply air 55 degrees. Heating supply air 94 degrees.

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COLORADO LICENSED PROFESSIONAL ENGINEER JEAN D. ANDRE 32983 6.1.2018

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Boulder County Building Services Division

JUSTICE CENTER DA INFILL

1777 6th St.
Boulder, CO 80302

SEH Project	135948
Project Manager	JDA
Drawn By	JDA
Project Status	Issue Date
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date

MECHANICAL SCHEDULES

M
001

Commercial (HVAC Only)
Prescriptive Measures Checklist

2017
City of Boulder
Energy Conservation Code

Applies to: New Buildings and Additions with a construction valuation of <$500,000; Alterations and Repairs are determined by construction valuations and should refer to Table C401.2.2.

Project Address: Date: 1/23/2018

DIRECTIONS: Compliance with these measures is required if the project uses the Prescriptive Compliance Path. Please complete this checklist and include it on an "Energy Conservation Code" sheet within the plans being submitted for permit application. Projects complying prescriptively also must meet Mandatory Measures and should include the Mandatory Measures Checklist as well.

Code Section	Focus Area	Code Description			Plan Drawing or Reference # to demonstrate compliance (N/A if not applicable)	Submitter Notes (e.g. If "N/A" Please explain why requirement does not apply or is not demonstrated on plans/specs)	Plans Examiner Notes (in office use)
HEATING, VENTILATING, AND AIR CONDITIONING- SIMPLE SYSTEMS							
C403.3.1	Air Side Economizer	Required for cooling systems ≥33,000 Btu/h					☐ Field Verify
C403.3.1.1.3		Controls HIGH LIMIT Shutoff	Fixed dry bulb	TOA > 75°F	N/A	Existing Air Handlers serving this new space were constructed under the 2010 RTU Replacement project. This project replaced all air handlers at this site with 100%OA Economizer, Heat wheel, evaporative cooling, chilled water cooling and hot water heating coil.	☐ Field Verify
			Differential dry bulb	TOA > TRA			
			Electronic Enthalpy	(TOA, RHOA) > A			
			Differential enthalpy	hOA > hRA			
			Dew-point and dry bulb temperatures	DPOA> 55°F or TOA> 75°F			
			Fixed enthalpy control	Prohibited			
C403.3.1.1.2		Control Signal	Economizer dampers capable sequencing with the mechanical cooling equipment and shall not be controlled by only mixed air temperature.		N/A	Existing Air Handlers AHU-1 and AHU-2 serving this new space were constructed under the 2010 RTU Replacement project.	☐ Field Verify
C403.3.1.1.1		Capacity	System is capable of modulating OA and RA dampers to provide up to 100 percent of the design supply air as outdoor air.		N/A	Existing Air Handlers AHU-1 and AHU-2 serving this new space were constructed under the 2010 RTU Replacement project.	☐ Field Verify
C403.3.1.1.4		Relief Damper	System equpped with relief mechanim		N/A	Existing Air Handlers AHU-1 and AHU-2 serving this new space were constructed under the 2010 RTU Replacement	☐ Field Verify
C403.4.1.1	Water Side Economizer	Capacity	Water economizer systems capacity to provide up to 100 percent of system cooling load at OAT 50°F dry bulb, 45°F wet bulb and below.		N/A	Existing Air Handlers AHU-1 and AHU-2 serving this new space were constructed under the 2010 RTU Replacement project. Chilled Water system supplements Evap Cooling.	☐ Field Verify
C403.4.1.3		Integration	integrated with the mechanical cooling system and be capable of providing partial cooling to supplement mechanical cooling.				
C403.4.2	VAVs	Fan Control	Individual VAV fans with motors of 7.5 horsepower (5.6 kW) or greater shall be: 1. Driven by a mechanical or electrical variable speed drive; 2. Driven by a vane-axial fan with variable-pitch blades; or 3. The fan shall have controls or devices that will result in fan motor demand of no more than 30 percent of their design wattage at 50 percent of design airflow when static pressure set point equals one-third of the total design static pressure, based on manufacturer's certified fan data.		N/A	Static pressure control of the exting dual supply fans is determined by the existing static pressure sensor.	
C403.4.2.1		Static Pressure Sensor	Static pressure sensors placed in a position such that the controller setpoint is no greater than one-third the total design fan static pressure. For sensors installed down-stream of major duct splits, at least one sensor shall be located on each major branch to ensure that static pressure can be maintained in each branch.				☐ Field Verify
C403.4.3		Hydronic heating systems comprised of a single boiler and greater than 500,000 Btu/h (146 550 W) input design capacity shall include either a multistaged or modulating burner.			N/A	Existing Air Handlers AHU-1 and AHU-2 serving this new space were constructed under the 2010 RTU Replacement project.	
C403.4.3.1		Three pipe system	Hydronic systems that use a common return system for both hot water and chilled water are prohibited.				
C403.4.3.3.2		Heat rejection	If an open- or closed-circuit cooling tower is used, a separate heat exchanger shall be provided to isolate the cooling tower from the heat pump loop, and heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop and providing an automatic valve to stop the flow of fluid.				
C403.4.3.3.3		Two position valve	Each hydronic heat pump on the hydronic system having a total pump system power exceed				

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SEH Project	135948
Project Manager	JDA
Drawn By	JDA

Project Status	Issue Date

Revision Issue

Rev. #	Description	Date

ENERGY CONSERVATION CODE

M
002

Code Section	Focus Area		Code Description		Plan Drawing or Reference # to demonstrate compliance (N/A if not applicable)	Submitter Notes (e.g. If "N/A" Please explain why requirement does not apply or is not demonstrated on plans/specs)	Plans Examiner Notes (in office use)
C403.4.3.4	Hydronic System	Part load controls	Systems ≥ 300,000 Btu/h must have capability to reduce system pump flow by at least 50 percent of design flow rate utilizing adjustable speed drive(s) on pump(s), or multiple-staged pumps where at least one-half of the total pump horsepower is capable of being automatically turned off or control valves designed to modulate or step down, and close, as a function of load, or other approved means.				
C403.4.3.5		Pump Isolation	Chilled water plants including more than one chiller shall have the capability to reduce flow automatically through the chiller plant when a chiller is shut down. Chillers piped in series for the purpose of increased temperature differential shall be considered as one chiller. Boiler plants including more than one boiler shall have the capability to reduce flow automatically through the boiler plant when a boiler is shut down.				☐ Field Verify
C403.4.4	Heat rejection equipment fan speed control		Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at two-thirds of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device.			Existing Air Handlers AHU-1 and AHU-2 serving this new space were constructed under the 2010 RTU Replacement project and are on VFDs.	☐ Field Verify
C403.4.5	Multi Zone System	Supply air systems	Shall be VAV systems which, during periods of occupancy, are designed and capable of being controlled to reduce primary air supply to each zone to one of the following before reheating, recooling or mixing takes place: 1. Thirty percent of the maximum supply air to each zone. 2. ≤300 cfm where the maximum flow rate is less than 10 percent of the total fan system supply airflow rate. 3. The minimum ventilation requirements of Chapter 4 of the International Mechanical Code.			Existing Air Handlers AHU-1 and AHU-2 serving this new space were constructed under the 2010 RTU Replacement project and are on VFDs.	
C403.4.5.1		Single duct VAV	Single duct VAV systems shall use terminal devices capable of reducing the supply of primary supply air before reheating or recooling takes place.				☐ Field Verify
C403.4.5.2	Multi Zone System	Dual Duct VAV	Systems that have one warm air duct and one cool air duct shall use terminal devices which are capable of reducing the flow from one duct to a minimum before mixing of air from the other duct takes place.		N/A	Existing air handlers are not multi zone systems.	
C403.4.5.3		Single fan dual duct and mixing VAV systems	Individual dual duct or mixing heating and cooling systems with a single fan and with total capacities greater than 90,000 Btu/h (7.5 tons) shall NOT be equipped with air economizers.				☐ Field Verify
C403.4.6	Heat recovery for service water heating		Condenser heat recovery shall be installed for heating or reheating of service hot water provided the facility operates 24 hours a day, the total installed heat capacity of water-cooled systems exceeds 6,000,000 Btu/hr of heat rejection, and the design service water heating load exceeds 1,000,000 Btu/h . The required heat recovery system shall have the capacity to provide the smaller of: 1. Sixty percent of the peak heat rejection load at design conditions; or 2. The preheating required to raise the peak service hot water draw to 85°F (29°C).		N/A	Service water heating is not modified under this project.	☐ Field Verify
C403.4.7	Hot gas bypass	Limitation	Cooling systems shall not use hot gas bypass or other evaporator pressure control systems unless the system is designed with multiple steps of unloading or continuous capacity modulation.		N/A	Hot gas bypass is not utilized in existing AHU-1 and AHU-2.	
		Maximum Capacity	≤ 240,000 Btu/h	50% of total capacity			
			> 240,000 Btu/h	25% of total capacity			☐ Field Verify

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JUSTICE CENTER DA INFILL

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SEH Project	135948
Project Manager	JDA
Drawn By	JDA

Project Status **Issue Date**

Revision Issue

Rev. #	Description	Date

ENERGY CONSERVATION CODE

M
003

Commercial (HVAC ONLY)
Mandatory Measures Checklist

2017
City of Boulder
Energy Conservation Code

Applies to: All New Buildings, Additions, Alterations and Repairs which require a permit from the City.

Project Address:

Date: 1/23/2018

DIRECTIONS: Compliance with these Mandatory Measures is required whether the project is demonstrating compliance through the Performance or Prescriptive Path. Please complete this checklist and include it on an "Energy Conservation Code" sheet within the plans being submitted for permit application.

Code Section	Focus Area	Code Description	Plan Drawing or Reference # to demonstrate compliance (N/A if not applicable)	Submitter Notes (e.g. If "N/A" Please explain why requirement does not apply or is not demonstrated on plans/specs)	Plans Examiner Notes (in office use)
HEATING, VENTILATING, AND AIR CONDITIONING					
C403.2.1	Load Calculations	Heating and cooling system design loads for the purpose of sizing systems and equipment shall be determined in accordance with ANSI/ASHRAE/ACCA Standard 183-2007, Peak Cooling and Heating Load Calculations in Buildings Except Low-Rise Residential Buildings.	N/A	Heating and cooling system design loads for the purpose of sizing systems and equipment have been determined in accordance with ANSI/ASHRAE/ACCA Standard 183-2007, Peak Cooling and Heating Load Calculations in Buildings Except Low-Rise Residential Buildings.	☐ Field Verify
C403.2.2	Equipment and system sizing	The output capacity of heating and cooling equipment and systems shall not exceed the loads calculated in accordance with Section C403.2.1. A single piece of equipment providing both heating and cooling shall satisfy this provision for one function with the capacity for the other function as small as possible, within available equipment options.		The existing air handlers serving this space provide heating and cooling via VAV terminals.	☐ Field Verify
C403.2.3	Equipment Efficiencies	Equipment shown in Tables C403.2.3(1) through C403.2.3(8) shall have a minimum performance at the specified rating conditions when tested in accordance with the specified test procedure. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements, unless otherwise exempted by footnotes in the table.		The existing air handlers serving this space are existing to remain units, complete with heat wheel, evaporative cooling supplemented by existing chillers rejecting heat via existing cooling towers.	☐ Field Verify
C403.2.4.1	Zone Thermostatic Controls	The supply of heating and cooling energy to each zone shall be individually controlled by thermostatic controls responding to temperature within the zone.		The supply of heating and cooling energy to each zone will be individually controlled by thermostatic controls responding to temperature within the zone.	☐ Field Verify
C403.2.4.2	Dead Band	Where used to control both heating and cooling, zone thermostatic controls shall be capable of providing a temperature range or dead band of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.		Where used to control both heating and cooling, zone thermostatic controls will be capable of providing a temperature range or dead band of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.	☐ Field Verify
C403.2.4.3.2	Off-hour Controls - Automatic Shutdown	HVAC systems shall be equipped with at least one of the following: a) Controls that can start and stop the system under different time schedules for seven different day-types per week, are capable of retaining programming and time setting during loss of power for a period of at least ten hours, and include an accessible manual override, or equivalent function, that allows temporary operation of the system for up to two hours. b) An occupant sensor that is capable of shutting the system off when no occupant is sensed for a period of up to 30 minutes. c) A manually operated timer capable of being adjusted to operate the system for up to two hours. d) An interlock to a security system that shuts the system off when the security system is activated.		HVAC systems are equipped with controls that can start and stop the system under different time schedules for seven different day-types per week, are capable of retaining programming and time setting during loss of power for a period of at least ten hours, and include an accessible manual override, or equivalent function, that allows temporary operation of the system for up to two hours.	☐ Field Verify

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Drawn By	JDA

Project Status **Issue Date**

Revision Issue

Rev. #	Description	Date

ENERGY CONSERVATION CODE

M
004

Code Section	Focus Area	Code Description	Plan Drawing or Reference # to demonstrate compliance (N/A if not applicable)	Submitter Notes (e.g. If "N/A" Please explain why requirement does not apply or is not demonstrated on plans/specs)	Plans Examiner Notes (in office use)
C403.2.4.3.1	Off-Hour Controls - Setback controls	Heating systems located in climate zones 2-8 shall be equipped with controls that have the capability to automatically restart and temporarily operate the system as required to maintain zone temperatures above a heating setpoint adjustable down to 55°F or lower. Cooling systems located in climate zones 1b, 2b, and 3b shall be equipped with controls that have the capability to automatically restart and temporarily operate the system as required to maintain zone temperatures below a cooling setpoint adjustable up to 90°F or higher to prevent high space humidity levels.		Heating systems located in climate zones 2-8 will be equipped with controls that have the capability to automatically restart and temporarily operate the system as required to maintain zone temperatures above a heating setpoint adjustable down to 55°F or lower. Cooling systems located in climate zones 1b, 2b, and 3b shall be equipped with controls that have the capability to automatically restart and temporarily operate the system as required to maintain zone temperatures below a cooling setpoint adjustable up to 90°F or higher to prevent high space humidity levels. Boulder is in Climate Zone 5; refer to heating systems only for this item.	☐ Field Verify
C403.2.4.5	HVAC System Shut Off	Directly conditioned spaces with operable wall or roof or overhed door openings to the outdoors shall be equipped with interlock controls that disable or reset the temperature setpoint for mechanical heating and cooling.	N/A	Not applicable for this project.	☐ Field Verify
C403.2.5	Ventilation	Natural or mechanical ventilation shall be provided in accordance with Chapter 4 of the International Mechanical Code. Demand control ventilation required for conditioned spaces larger than 500 ft2 with an average occupancy of 25 people/ 1,000ft2. Exceptions apply.		Natural or mechanical ventilation will be provided in accordance with Chapter 4 of the International Mechanical Code. Demand control ventilation required for conditioned spaces larger than 500 ft2 with an average occupancy of 25 people/ 1,000ft2. CO2 Monitors will be provided for conference rooms.	☐ Field Verify
C403.2.6	Energy Recovery Ventilators	Where supply airflow rates exceed values in Table C403.2.6, heating energy recovery is required.		The existing air handlers serving this space is a multiple zone system with energy recovery.	☐ Field Verify
C403.2.4.1.1	Heat Pump Auxiliary Heat Control	Heat pumps having supplementary electric resistance heat shall have controls that, except during defrost, prevent supplementary heat operation where the heat pump can meet the heating load.		Heat pumps are not provided in the scope of this project.	☐ Field Verify
C403.2.4.1	Humidification and Dehumidification	Where a zone is served by a system or systems with both humidification and dehumidification capability, means (such as limit switches, mechanical stops, or, for DDC systems, software programming) shall be provided capable of preventing simultaneous operation of humidification and dehumidification equipment.		The existing air handler controls serving this space are capable of preventing simultaneous operation of humidification and dehumidification equipment.	☐ Field Verify
C403.2.7	HVAC Systems Construction and Installation - Duct and	All supply and return air ducts and plenums shall be insulated with a minimum of R-6 insulation where located in unconditioned spaces and a minimum of R-8 insulation where located outside the building. Where located within a building		All supply and return air ducts and plenums will be insulated with a minimum of R-6 insulation where located in unconditioned spaces and a minimum of R-8 insulation	☐ Field Verify
C403.2.7.1	Duct Construction	Ductwork shall be constructed and erected in accordance with the International Mechanical Code.		Ductwork will be constructed and erected in accordance with the International Mechanical Code.	☐ Field Verify

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4.1.2018

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SEH Project	135948
Project Manager	JDA
Drawn By	JDA

Project Status	Issue Date

Revision Issue

Rev. #	Description	Date

ENERGY CONSERVATION CODE

M
005

Code Section	Focus Area	Code Description	Plan Drawing or Reference # to demonstrate compliance (N/A if not applicable)	Submitter Notes (e.g. If "N/A" Please explain why requirement does not apply or is not demonstrated on plans/specs)	Plans Examiner Notes (in office use)
C403.2.7.1.1 and C403.2.7.1.2	Low and Medium Pressure duct systems	All longitudinal and transverse joints, seams and connection...less than or equal to 2 inches water gauge (w.g.) (500 Pa) shall be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus embedded- fabric systems or tapes installed in accordance with the manufacturer's installation instructions. Pressure classifications specific to the duct system shall be clearly indicated on the construction documents in accordance with the International Mechanical Code. All ducts and plenums designed to operate at a static pressure greater than 2 inches water gauge (w.g.) (500 Pa) but less than 3 inches w.g. (750 Pa) shall be insulated and sealed in accordance with Section C403.2.7. Pressure classifications specific to the duct system shall be clearly indicated on the construction documents in accordance with the International Mechanical Code.		All longitudinal and transverse joints, seams and connection...less than or equal to 2 inches water gauge (w.g.) (500 Pa) will be securely fastened and sealed with welds, gaskets, mastics (adhesives), mastic-plus embedded-fabric systems or tapes installed in accordance with the manufacturer's installation instructions. Pressure classifications specific to the duct system will be clearly indicated on the construction documents in accordance with the International Mechanical Code. All ducts and plenums designed to operate at a static pressure greater than 2 inches water gauge (w.g.) (500 Pa) but less than 3 inches w.g. (750 Pa) will be insulated and sealed in accordance with Section C403.2.7. Pressure classifications specific to the duct system shall be clearly indicated on the construction documents in accordance with the International Mechanical Code.	☐ Field Verify
C403.2.7.1.3	Duct Leakage tests / High pressure ducts	Ductwork that is designed to operate at static pressures in excess of 3 in. w.c. and all ductwork located outdoors shall be leak-tested according to industry-accepted test procedures (see Informative Appendix E). Representative sections totaling no less than 25% of the total installed duct area for the designated pressure class shall be tested. All sections shall be slected by the building owner or the designated representative of the building owner. Positive pressure leakage testing is acceptable for negative pressure ductwork. The maximum permitted duct leakage shall be LMAX=CLP0.65	N/A		☐ Field Verify
C403.2.8	Piping Insulation	Piping shall be thermally insulated in accordance with Table C403.2.8.		Piping will be thermally insulated in accordance with Table C403.2.8.	☐ Field Verify
C403.2.8.1	Protection of Piping Insulation	Piping insulation exposed to weather shall be protected from damage, including that due to sunlight, moisture, equipment maintenance and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Adhesives tape shall not be permitted.		Piping insulation exposed to weather will be protected from damage, including that due to sunlight, moisture, equipment maintenance and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Adhesives tape shall not be permitted.	☐ Field Verify
C402.2.8	Radiant Floor Heating	The bottom surfaces of floor structures incorporating radiant heating shall be insulated with a minimum of R-3.5. Adjacent envelope insulation counts toward this requirement.	N/A		☐ Field Verify
C403.2.10	Fan Power	Each HVAC system having a total fan system motor nameplate horsepower exceeding 5 hp shall meet the provisions of C403.2.10.		The air handlers serving this project are existing dual direct drive plenum fans to remain.	☐ Field Verify
C403.2.11	Outside Heating	Systems installed to provide heating outside a building shall be radiant systems and shall be controlled by an occupancy sensing devise or timer switch.	N/A		☐ Field Verify

SYSTEM COMMISSIONING

Code Section	Focus Area	Code Description	Plan Drawing or Reference # to demonstrate compliance (N/A if not applicable)	Submitter Notes (e.g. If "N/A" Please explain why requirement does not apply or is not demonstrated on plans/specs)	Plans Examiner Notes (in office use)
C407.2	Mechanical System Commissioning and Completion Requirements	Prior to passing the final mechanical inspection, the registered design professional shall provide evidence of mechanical systems commissioning and completion in accordance the provisions of this section.		Prior to passing the final mechanical inspection, the registered design professional will provide evidence of mechanical systems commissioning and completion in accordance the provisions of this section.	Documentation Required [ ] Commissioning Report [ ] System Balancing Report

ADDITIONAL SUSTAINABILITY MEASURES

IPC Table 604.4	Water Efficiency	Revised plumbing code fixture flow rates: Lavatory, private 1.5 gpm at 60 psi Lavatory, public (metering) 0.25 gallon per metering cycle Lavatory, public (no metering) 0.5 gpm at 60 psi Shower head 2.0 gpm at 80 psi Sink Faucet 1.5 gpm at 60 psi Urinal 1.0 gallon per flushing cycle Water Closet 1.28 gallons per flushing cycle		Revised plumbing code fixture flow rates: N/A Lavatory, private 1.5 gpm at 60 psi N/A Lavatory, public (metering) 0.25 gallon per metering cycle Lavatory, public (no metering) 0.5 gpm at 60 psi N/A Shower head 2.0 gpm at 80 psi Sink Faucet 1.5 gpm at 60 psi Urinal 0.25 gallon per flushing cycle Water Closet 1.28 gallons per flushing cycle	☐ Field Verify

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SEH Project	135948
Project Manager	JDA
Drawn By	JDA

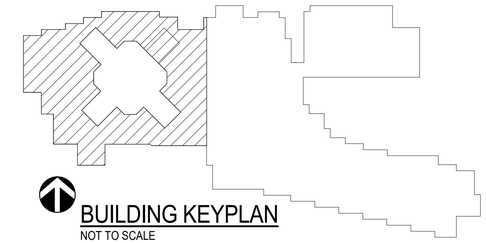
Project Status	Issue Date

Revision Issue

Rev. #	Description	Date

ENERGY CONSERVATION CODE

M
006



BUILDING KEYPLAN
NOT TO SCALE

BUILDING AREA TO BE DEMOLISHED
RE: ARCH

CRAWL SPACE GENERAL NOTES

1. THIS PROJECT IS DIVIDED INTO TWO PHASES: "CORE AND SHELL" AND "TENANT INTERIORS". REFER TO SECTION 011100 RESPONSIBILITY MATRIX IN THE PROJECT MANUAL FOR A DETAILED BREAKDOWN OF WORK IN EACH PHASE.
2. REMOVE EXISTING EQUIPMENT AND ALL APPURTENANCES COMPLETELY.
3. FIRST LEVEL WALLS ABOVE SHOWN FOR REFERENCE ONLY.

MECHANICAL REMOVAL PLAN - CRAWL SPACE
1/8" = 1'-0"
4' 2' 0' 4' 8' 16'

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SEH Project	135948
Project Manager	JDA
Drawn By	JDA

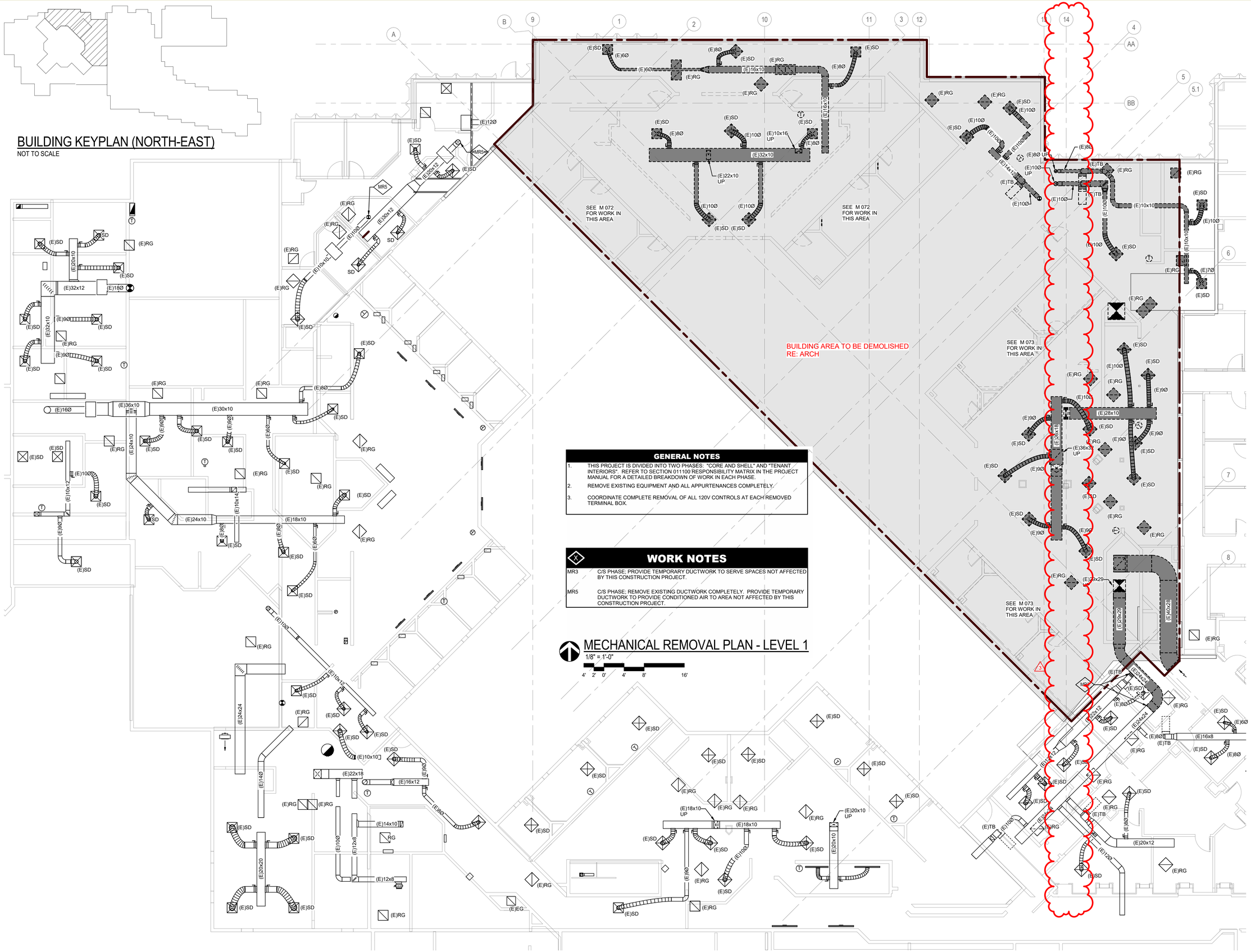
Project Status	Issue Date
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date
3	PERMIT COMMENTS	06/01/2018

MECHANICAL REMOVAL PLAN - CRAWL SPACE

M
070



BUILDING KEYPLAN (NORTH-EAST)

NOT TO SCALE

GENERAL NOTES

1. THIS PROJECT IS DIVIDED INTO TWO PHASES: "CORE AND SHELL" AND "TENANT INTERIORS". REFER TO SECTION 011100 RESPONSIBILITY MATRIX IN THE PROJECT MANUAL FOR A DETAILED BREAKDOWN OF WORK IN EACH PHASE.
2. REMOVE EXISTING EQUIPMENT AND ALL APPURTENANCES COMPLETELY.
3. COORDINATE COMPLETE REMOVAL OF ALL 120V CONTROLS AT EACH REMOVED TERMINAL BOX.

WORK NOTES

MR3	C/S PHASE; PROVIDE TEMPORARY DUCTWORK TO SERVE SPACES NOT AFFECTED BY THIS CONSTRUCTION PROJECT.
MR5	C/S PHASE; REMOVE EXISTING DUCTWORK COMPLETELY. PROVIDE TEMPORARY DUCTWORK TO PROVIDE CONDITIONED AIR TO AREA NOT AFFECTED BY THIS CONSTRUCTION PROJECT.

MECHANICAL REMOVAL PLAN - LEVEL 1

1/8" = 1'-0"

4' 2' 0' 4' 8' 16'

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SEH Project	135948
Project Manager	JDA
Drawn By	JDA

Project Status	Issue Date
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date
3	PERMIT COMMENTS	06/01/2018

MECHANICAL REMOVAL PLAN - LEVEL 1

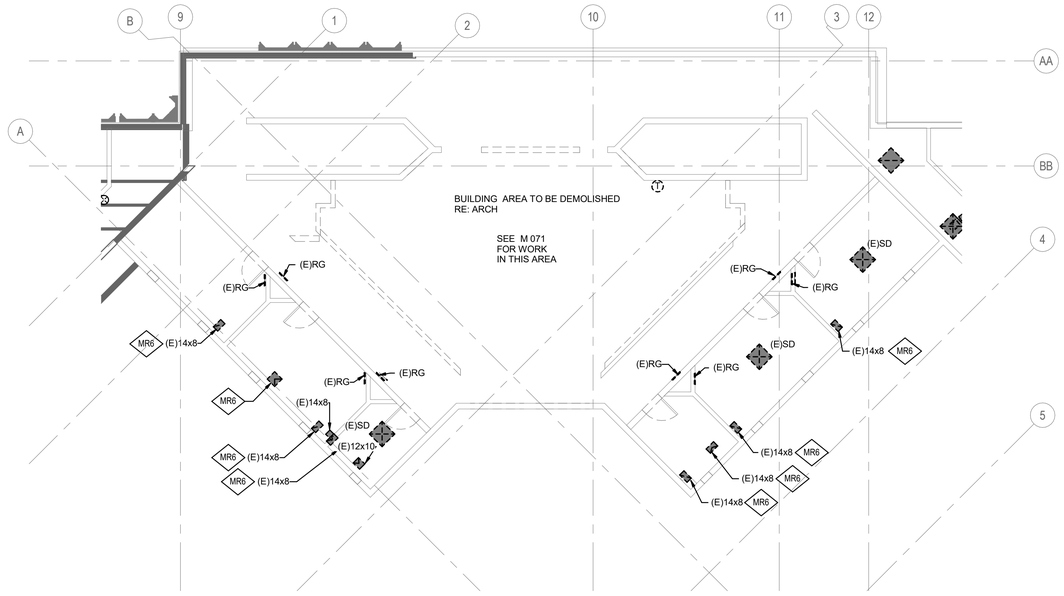
M
071

GENERAL NOTES

1. THIS PROJECT IS DIVIDED INTO TWO PHASES: "CORE AND SHELL" AND "TENANT INTERIORS". REFER TO SECTION 011100 RESPONSIBILITY MATRIX IN THE PROJECT MANUAL FOR A DETAILED BREAKDOWN OF WORK IN EACH PHASE.
2. REMOVE EXISTING EQUIPMENT AND ALL APPURTENANCES COMPLETELY.
3. COORDINATE COMPLETE REMOVAL OF ALL 120V CONTROLS AT EACH REMOVED TERMINAL BOX.

WORK NOTES

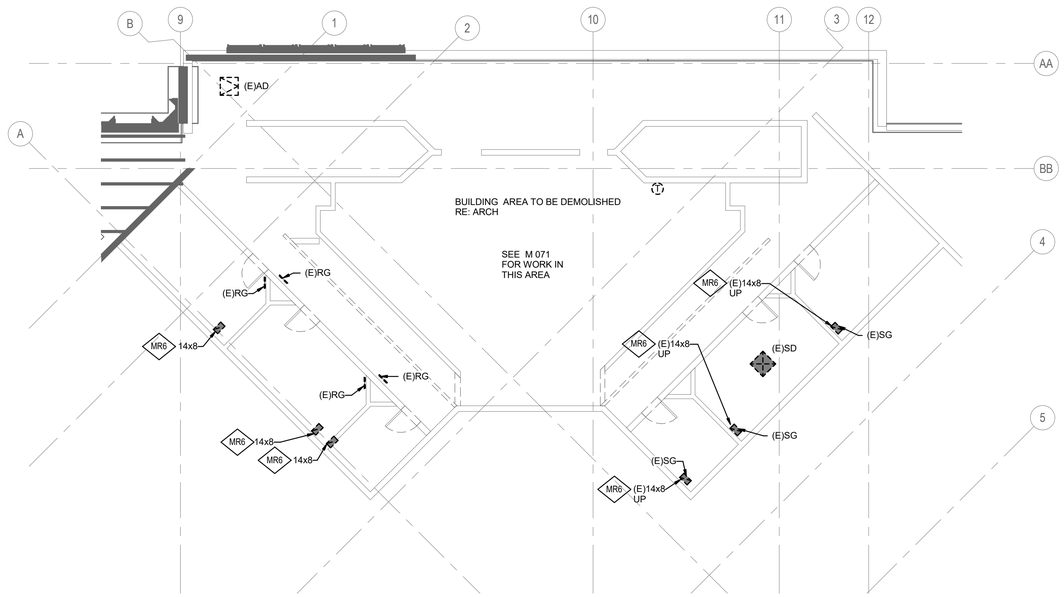
MR6	C/S PHASE: REMOVE EXISTING DUCT UP THROUGH FLOOR LEVEL, REMOVE CONNECTED EQUIPMENT COMPLETELY.



MEZZANINE LEVEL REMOVAL PLAN - (E)RTU-1 POD

1/8" = 1'-0"

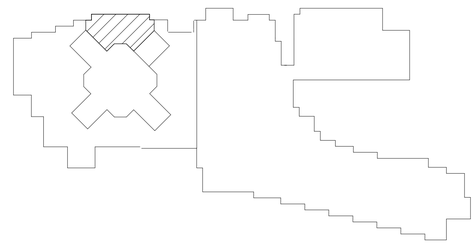
4' 2' 0' 4' 8' 16'



GARDEN LEVEL REMOVAL PLAN - (E)RTU-1 POD

1/8" = 1'-0"

4' 2' 0' 4' 8' 16'



BUILDING KEYPLAN (NORTH)

NOT TO SCALE

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SEH Project	135948
Project Manager	JDA
Drawn By	JDA

Project Status	**Issue Date**
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date

MECHANICAL REMOVAL PLAN - GARDEN LEVELS NORTH POD

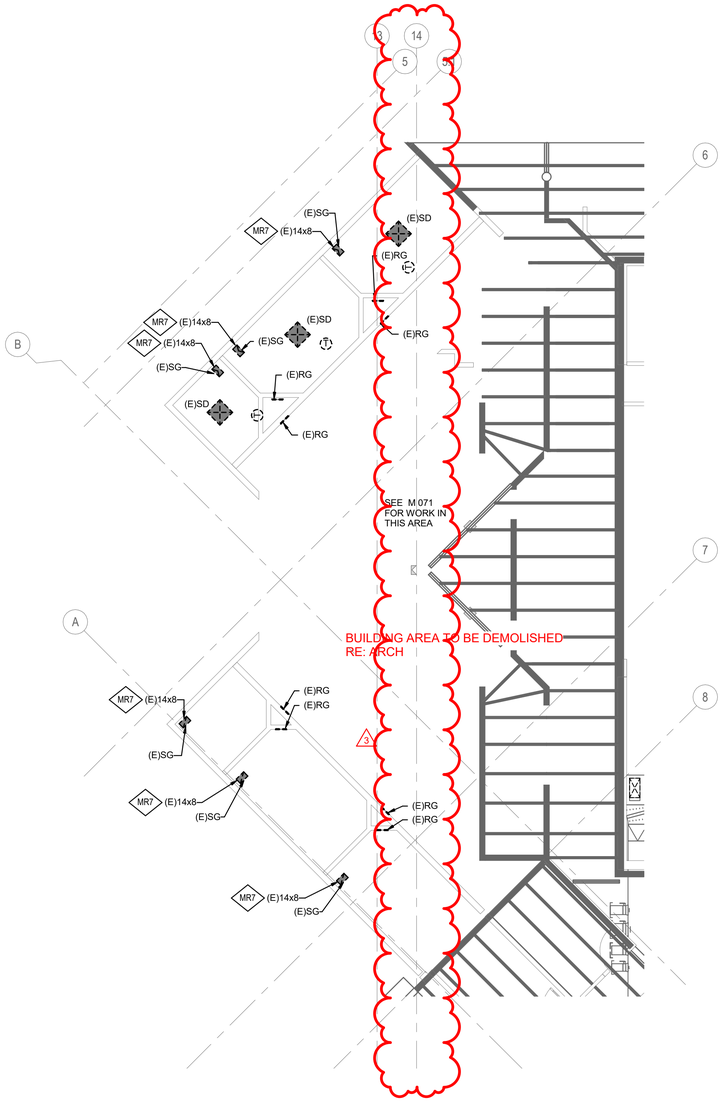
M
072

GENERAL NOTES

1. THIS PROJECT IS DIVIDED INTO TWO PHASES: "CORE AND SHELL" AND "TENANT INTERIORS". REFER TO SECTION 011100 RESPONSIBILITY MATRIX IN THE PROJECT MANUAL FOR A DETAILED BREAKDOWN OF WORK IN EACH PHASE.
2. REMOVE EXISTING EQUIPMENT AND ALL APPURTENANCES COMPLETELY.
3. COORDINATE COMPLETE REMOVAL OF ALL 120V CONTROLS AT EACH REMOVED TERMINAL BOX.

WORK NOTES

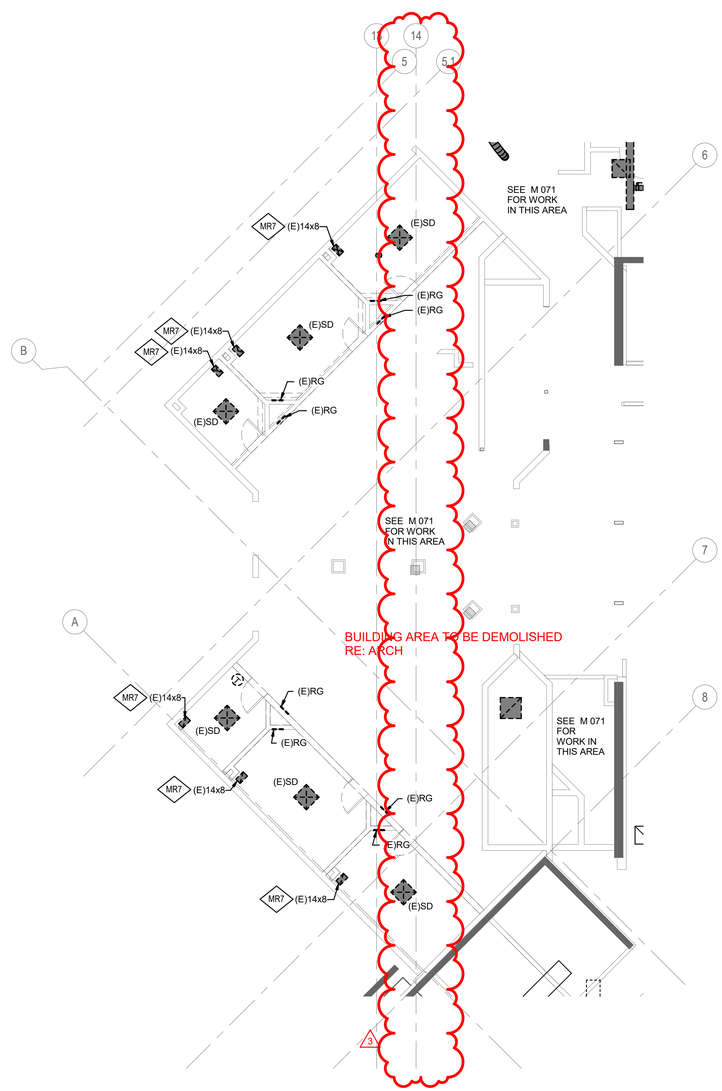
MR7	C/S PHASE; REMOVE EXISTING EQUIPMENT AND DUCTWORK COMPLETELY; TYPICAL.



GARDEN LEVEL REMOVAL PLAN - RTU-2 POD

1/8" = 1'-0"

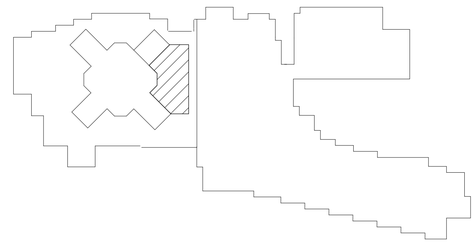
4' 2' 0' 4' 8' 16'



MEZZANINE LEVEL REMOVAL PLAN - RTU-2 POD

1/8" = 1'-0"

4' 2' 0' 4' 8' 16'



BUILDING KEYPLAN (EAST)

NOT TO SCALE

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COLORADO LICENSED PROFESSIONAL ENGINEER DEAN T. SCHMIDT 32983 6.1.2018

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SEH Project	135948
Project Manager	JDA
Drawn By	JDA

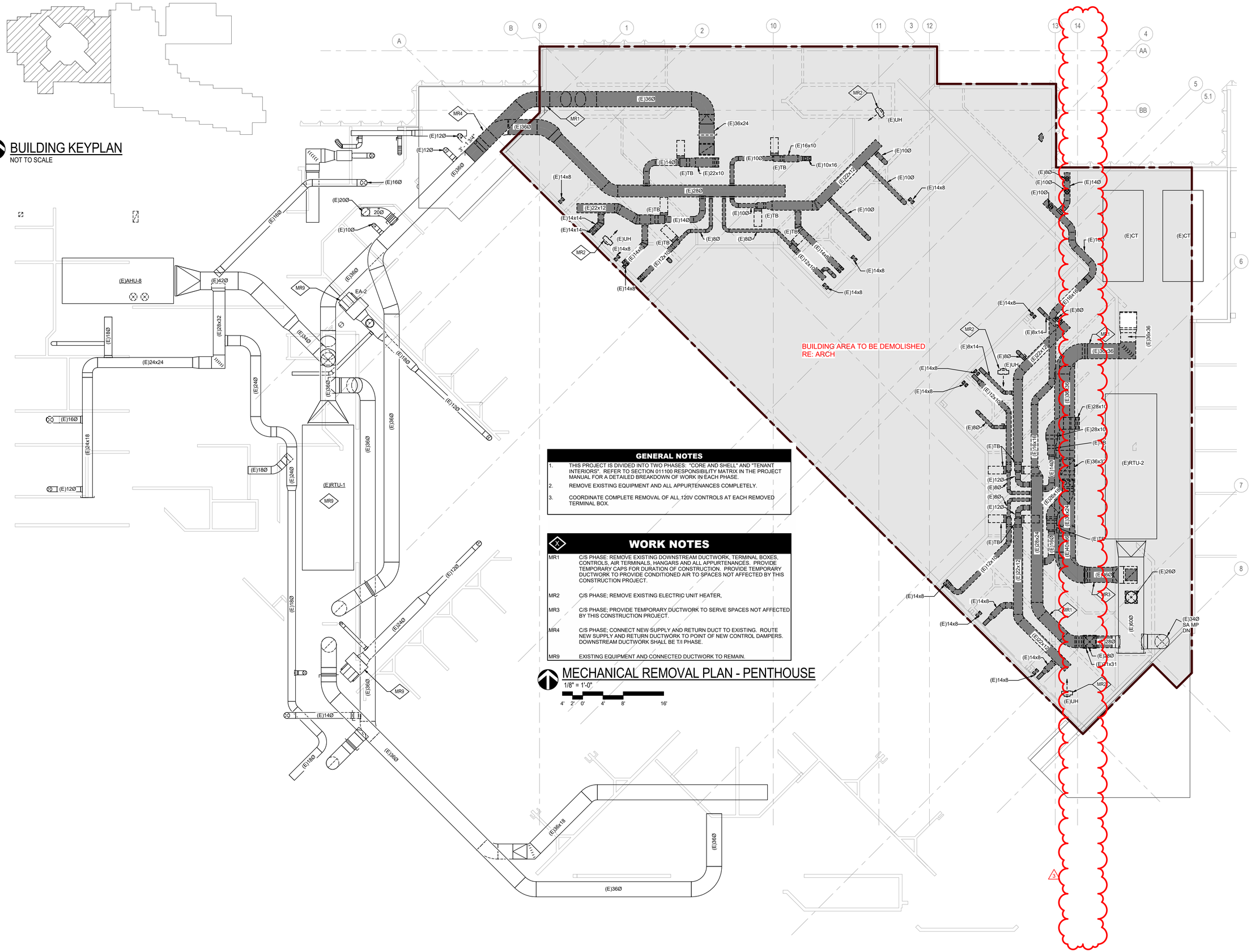
Project Status	Issue Date
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date
3	PERMIT COMMENTS	06/01/2018

MECHANICAL REMOVAL PLAN - GARDEN LEVELS EAST POD

M
073



BUILDING KEYPLAN
NOT TO SCALE

GENERAL NOTES

1. THIS PROJECT IS DIVIDED INTO TWO PHASES: "CORE AND SHELL" AND "TENANT INTERIORS". REFER TO SECTION 011100 RESPONSIBILITY MATRIX IN THE PROJECT MANUAL FOR A DETAILED BREAKDOWN OF WORK IN EACH PHASE.
2. REMOVE EXISTING EQUIPMENT AND ALL APPURTENANCES COMPLETELY.
3. COORDINATE COMPLETE REMOVAL OF ALL 120V CONTROLS AT EACH REMOVED TERMINAL BOX.

WORK NOTES

MR1	C/S PHASE: REMOVE EXISTING DOWNSTREAM DUCTWORK, TERMINAL BOXES, CONTROLS, AIR TERMINALS, HANGARS AND ALL APPURTENANCES. PROVIDE TEMPORARY CAPS FOR DURATION OF CONSTRUCTION. PROVIDE TEMPORARY DUCTWORK TO PROVIDE CONDITIONED AIR TO SPACES NOT AFFECTED BY THIS CONSTRUCTION PROJECT.
MR2	C/S PHASE; REMOVE EXISTING ELECTRIC UNIT HEATER,
MR3	C/S PHASE; PROVIDE TEMPORARY DUCTWORK TO SERVE SPACES NOT AFFECTED BY THIS CONSTRUCTION PROJECT.
MR4	C/S PHASE; CONNECT NEW SUPPLY AND RETURN DUCT TO EXISTING. ROUTE NEW SUPPLY AND RETURN DUCTWORK TO POINT OF NEW CONTROL DAMPERS. DOWNSTREAM DUCTWORK SHALL BE T/I PHASE.
MR9	EXISTING EQUIPMENT AND CONNECTED DUCTWORK TO REMAIN.

MECHANICAL REMOVAL PLAN - PENTHOUSE
1/8" = 1'-0"

4' 2' 0' 4' 8' 16'

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SEH Project	135948
Project Manager	JDA
Drawn By	JDA

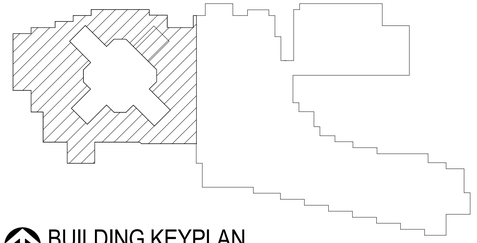
Project Status	Issue Date
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date
3	PERMIT COMMENTS	06/01/2018

MECHANICAL REMOVAL PLAN - LEVEL 2

M
074



BUILDING KEYPLAN
NOT TO SCALE

BUILDING AREA TO BE DEMOLISHED
RE: ARCH

CRAWL SPACE GENERAL NOTES

1. THIS PROJECT IS DIVIDED INTO TWO PHASES: "CORE AND SHELL" AND "TENANT INTERIORS". REFER TO SECTION 011100 RESPONSIBILITY MATRIX IN THE PROJECT MANUAL FOR A DETAILED BREAKDOWN OF WORK IN EACH PHASE.
2. REMOVE EXISTING EQUIPMENT AND ALL APPURTENANCES COMPLETELY.
3. FIRST LEVEL WALLS ABOVE SHOWN FOR REFERENCE ONLY.

WORK NOTES

HR4	C/S PHASE; REMOVE HWS/HWR AND CWS/CWR PIPING THROUGHOUT AREA OF WORK. REFER TO NEW WORK PLAN FOR NEW CONNECTIONS.
HR9	REMOVE EXISTING 1" GAS PIPING TO POINT BELOW FIRST FLOOR FOR CONNECTION TO NEW GAS PIPING.
HR10	C/S PHASE; REMOVE EXISTING PIPING TO THIS POINT.

PIPING REMOVAL PLAN - CRAWL SPACE
1/8" = 1'-0"

4' 2' 0' 4' 8' 16'

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COLORADO LICENSED — DEAN T. SHORT — 32983 — PROFESSIONAL ENGINEER
6·1·2018

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MECHANICAL PIPING REMOVAL PLAN - CRAWL SPACE

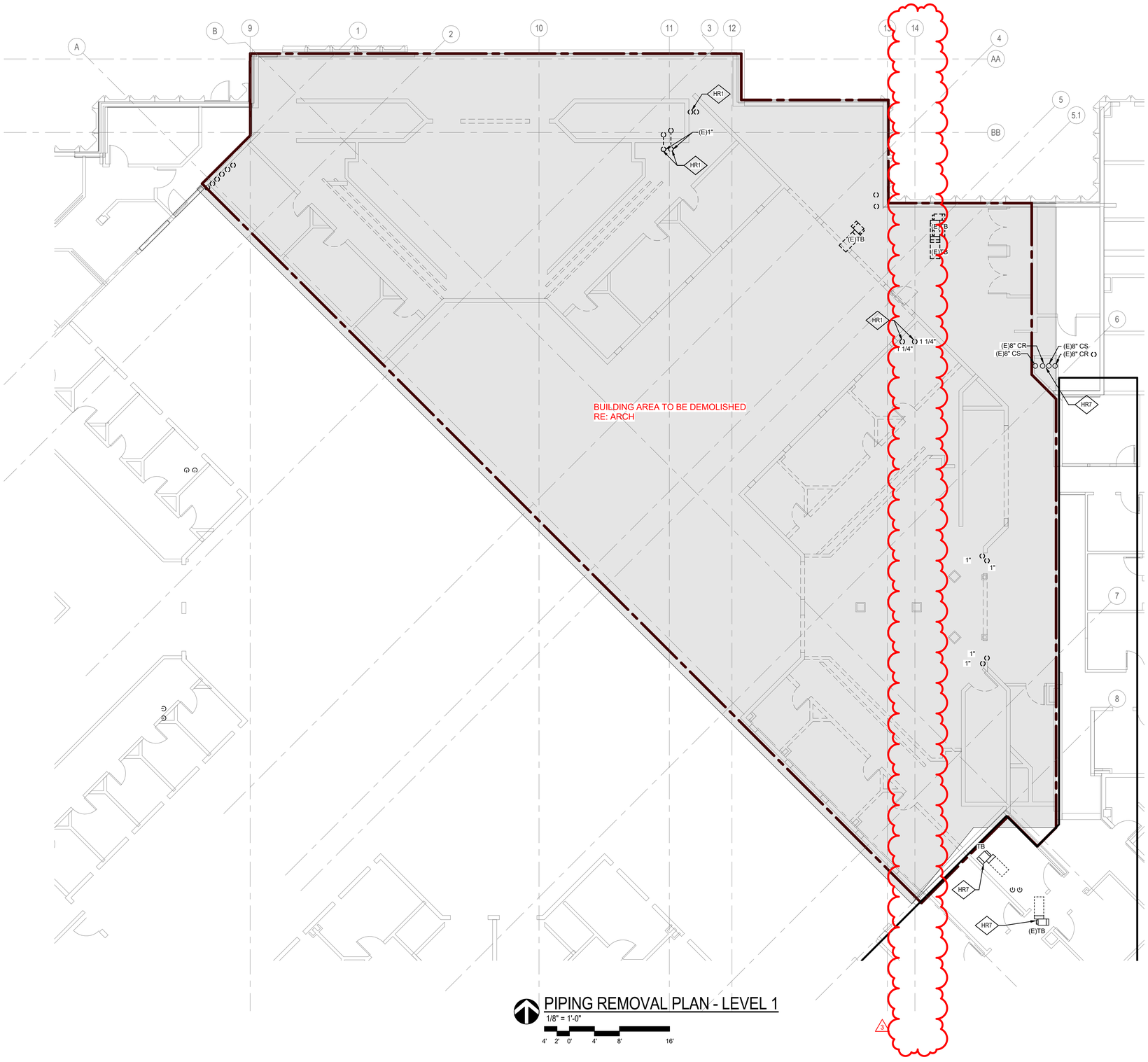
M
080

GENERAL NOTES

1. THIS PROJECT IS DIVIDED INTO TWO PHASES: "CORE AND SHELL" AND "TENANT INTERIORS". REFER TO SECTION 011100 RESPONSIBILITY MATRIX IN THE PROJECT MANUAL FOR A DETAILED BREAKDOWN OF WORK IN EACH PHASE.
2. REMOVE ALL EQUIPMENT AS SHOWN INCLUDING HANGARS, PIPING, VALVES AND CONTROLS.
3. REMOVE ALL EXISTING PIPING WITHIN PROJECT SCOPE AS DENOTED.

WORK NOTES

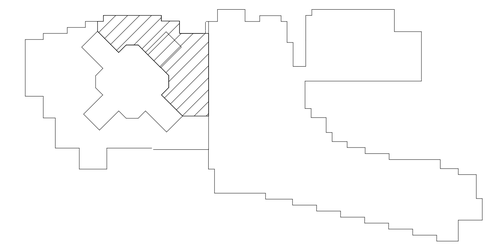
HR1	C/S PHASE; EXISTING PIPING TO BE REMOVED. CAP EXISTING PIPING TO REMAIN.
HR7	EXISTING PIPING TO REMAIN.



PIPING REMOVAL PLAN - LEVEL 1

1/8" = 1'-0"

4' 2' 0' 4' 8' 16'



BUILDING KEYPLAN (NORTH-EAST)

NOT TO SCALE

SEH

Building a Better World for All of Us®

COLORADO LICENSED PROFESSIONAL ENGINEER JEAN D. ANDRE 32983 6.1.2018

Owner
Boulder County
Building Services Division
2020 13th Street
Boulder, Colorado 80302
303.441.3925

Architect / Landscape
Short Elliott Hendrickson, Inc.
2000 South Colorado Boulevard
Tower One, Suite 6000
Denver, Colorado 80222
720.540.6800

Civil / Structural
JVA, Inc.
1319 Spruce St.
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303.444.1951

MEP Engineer
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5420 Ward Rd.
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303.422.7400

Boulder County Building Services Division

JUSTICE CENTER DA INFILL

1777 6th St.
Boulder, CO 80302

SEH Project	135948
Project Manager	JDA
Drawn By	JDA

Project Status	**Issue Date**
CONSTRUCTION DOCUMENTS	11/09/2017

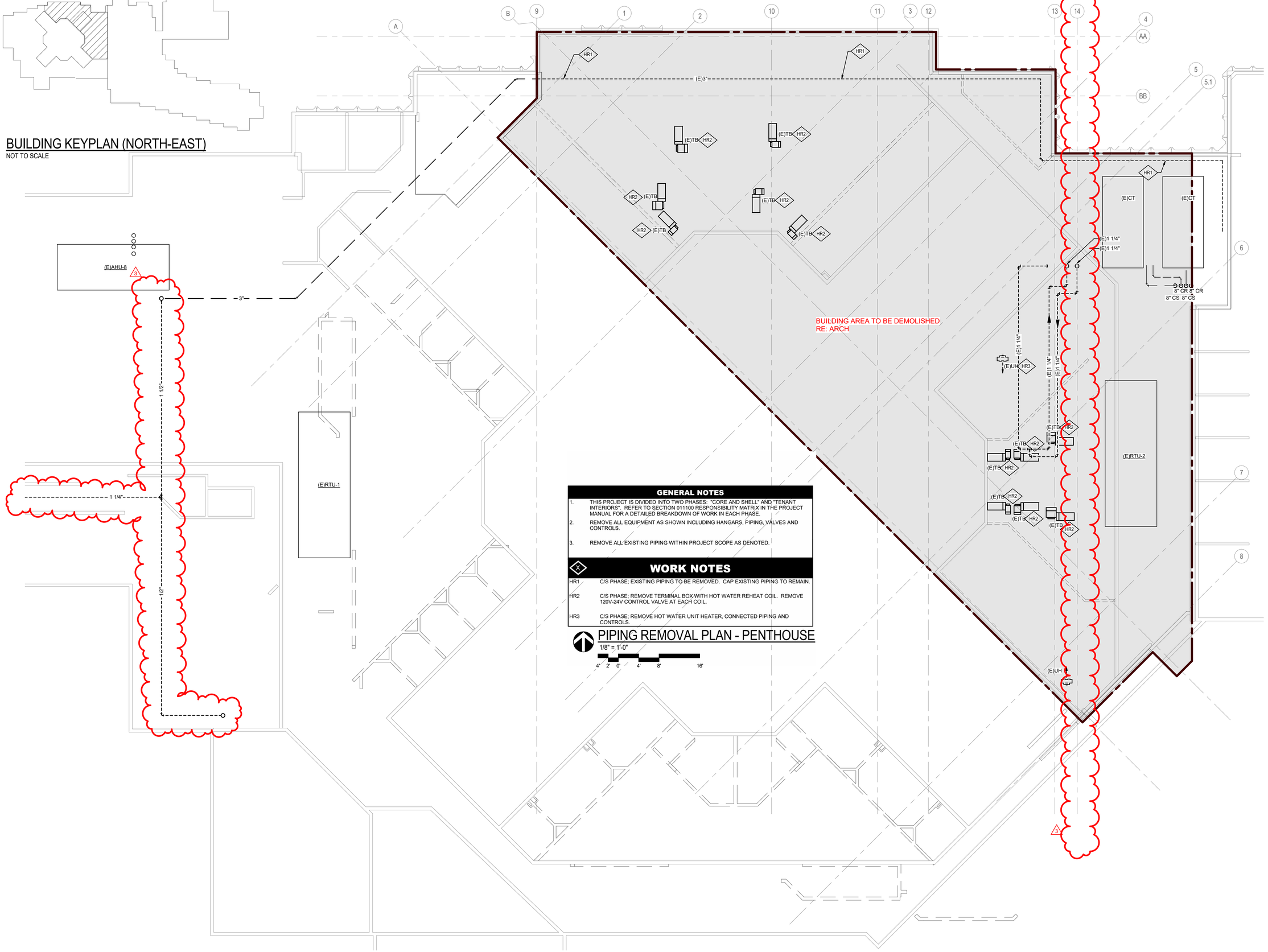
Revision Issue

Rev. #	Description	Date
3	PERMIT COMMENTS	06/01/2018

MECHANICAL PIPING REMOVAL PLAN - LEVEL 1

M
081

BUILDING KEYPLAN (NORTH-EAST)
NOT TO SCALE



GENERAL NOTES	
1.	THIS PROJECT IS DIVIDED INTO TWO PHASES: "CORE AND SHELL" AND "TENANT INTERIORS". REFER TO SECTION 011100 RESPONSIBILITY MATRIX IN THE PROJECT MANUAL FOR A DETAILED BREAKDOWN OF WORK IN EACH PHASE.
2.	REMOVE ALL EQUIPMENT AS SHOWN INCLUDING HANGARS, PIPING, VALVES AND CONTROLS.
3.	REMOVE ALL EXISTING PIPING WITHIN PROJECT SCOPE AS DENOTED.

X	WORK NOTES
HR1	C/S PHASE; EXISTING PIPING TO BE REMOVED. CAP EXISTING PIPING TO REMAIN.
HR2	C/S PHASE; REMOVE TERMINAL BOX WITH HOT WATER REHEAT COIL. REMOVE 120V-24V CONTROL VALVE AT EACH COIL.
HR3	C/S PHASE; REMOVE HOT WATER UNIT HEATER, CONNECTED PIPING AND CONTROLS.

PIPING REMOVAL PLAN - PENTHOUSE
1/8" = 1'-0"

4' 2' 0' 4' 8' 16'

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COLORADO LICENSED JEAN A. SCHMIDT 32983 PROFESSIONAL ENGINEER
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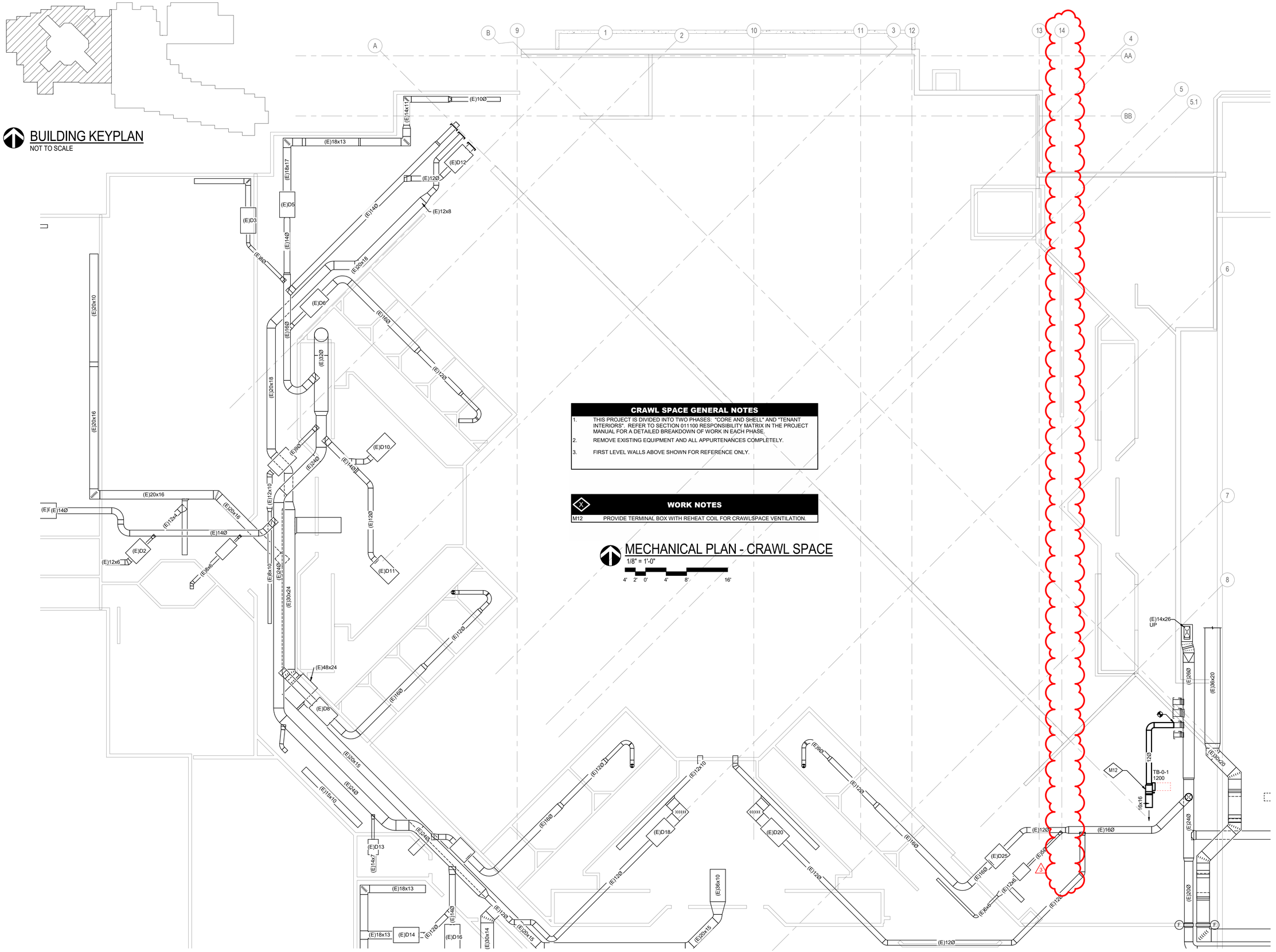
MECHANICAL PIPING REMOVAL PLAN - LEVEL 2

M
082



BUILDING KEYPLAN
NOT TO SCALE

CRAWL SPACE GENERAL NOTES

1. THIS PROJECT IS DIVIDED INTO TWO PHASES: "CORE AND SHELL" AND "TENANT INTERIORS". REFER TO SECTION 011100 RESPONSIBILITY MATRIX IN THE PROJECT MANUAL FOR A DETAILED BREAKDOWN OF WORK IN EACH PHASE.
2. REMOVE EXISTING EQUIPMENT AND ALL APPURTENANCES COMPLETELY.
3. FIRST LEVEL WALLS ABOVE SHOWN FOR REFERENCE ONLY.

WORK NOTES

M12 PROVIDE TERMINAL BOX WITH REHEAT COIL FOR CRAWLSPACE VENTILATION.

MECHANICAL PLAN - CRAWL SPACE
1/8" = 1'-0"

4' 2' 0' 4' 8' 16'

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DEAN A. SCHMIDT
32983
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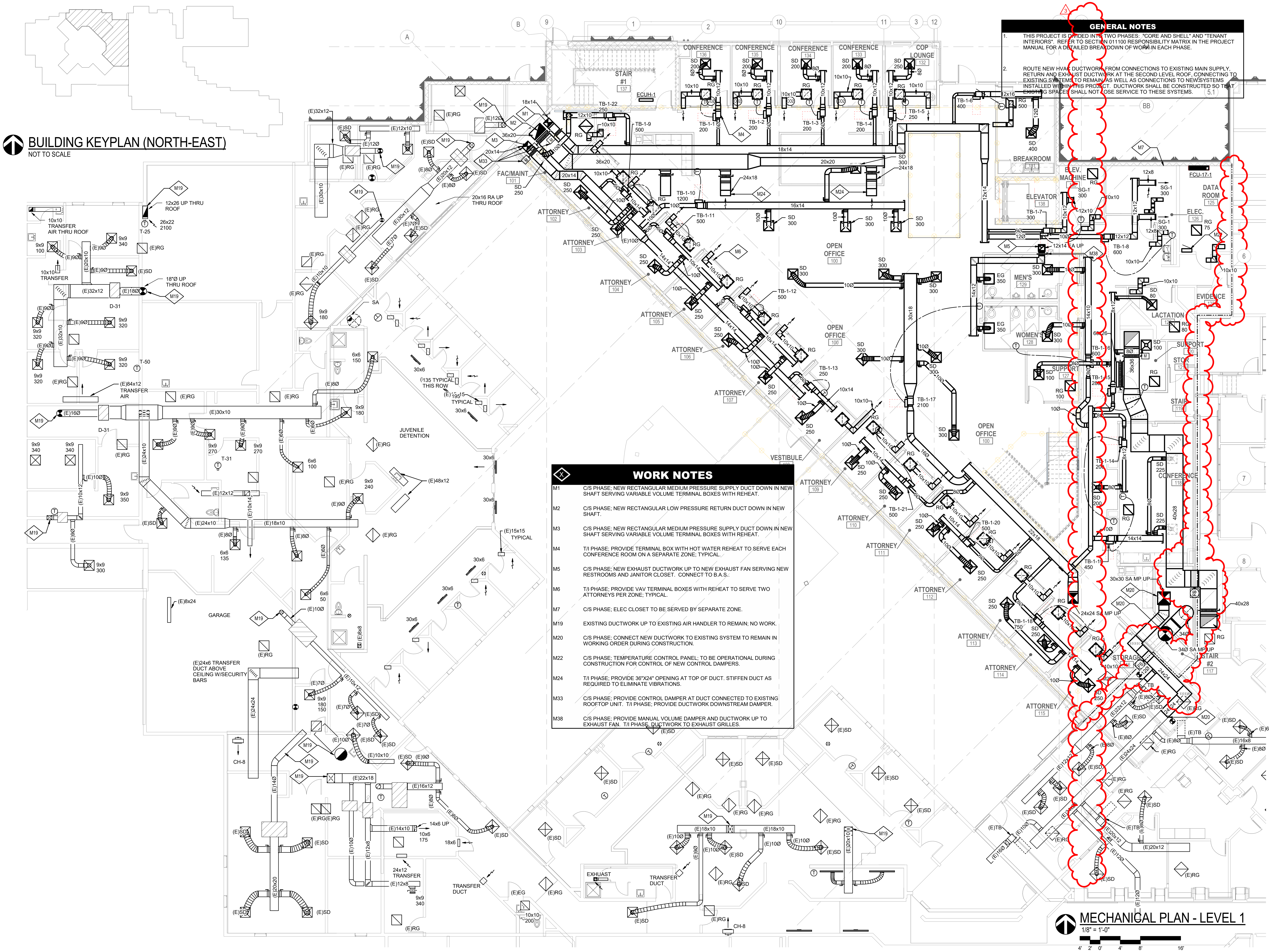
MECHANICAL PLAN - CRAWL SPACE

M
200



BUILDING KEYPLAN (NORTH-EAST)

NOT TO SCALE

MECHANICAL PLAN - LEVEL 1

1/8" = 1'-0"

GENERAL NOTES

1. THIS PROJECT IS DIVIDED INTO TWO PHASES: "CORE AND SHELL" AND "TENANT INTERIORS". REFER TO SECTION 011100 RESPONSIBILITY MATRIX IN THE PROJECT MANUAL FOR A DETAILED BREAKDOWN OF WORK IN EACH PHASE.

2. ROUTE NEW HVAC DUCTWORK, FROM CONNECTIONS TO EXISTING MAIN SUPPLY, RETURN AND EXHAUST DUCTWORK AT THE SECOND LEVEL ROOF, CONNECTING TO EXISTING SYSTEMS TO REMAIN, AS WELL AS CONNECTIONS TO NEW SYSTEMS INSTALLED WITHIN THIS PROJECT. DUCTWORK SHALL BE CONSTRUCTED SO THAT EXISTING SPACES SHALL NOT LOSE SERVICE TO THESE SYSTEMS.

WORK NOTES

M1	C/S PHASE; NEW RECTANGULAR MEDIUM PRESSURE SUPPLY DUCT DOWN IN NEW SHAFT SERVING VARIABLE VOLUME TERMINAL BOXES WITH REHEAT.
M2	C/S PHASE; NEW RECTANGULAR LOW PRESSURE RETURN DUCT DOWN IN NEW SHAFT.
M3	C/S PHASE; NEW RECTANGULAR MEDIUM PRESSURE SUPPLY DUCT DOWN IN NEW SHAFT SERVING VARIABLE VOLUME TERMINAL BOXES WITH REHEAT.
M4	T/I PHASE; PROVIDE TERMINAL BOX WITH HOT WATER REHEAT TO SERVE EACH CONFERENCE ROOM ON A SEPARATE ZONE; TYPICAL.
M5	C/S PHASE; NEW EXHAUST DUCTWORK UP TO NEW EXHAUST FAN SERVING NEW RESTROOMS AND JANITOR CLOSET. CONNECT TO B.A.S..
M6	T/I PHASE; PROVIDE VAV TERMINAL BOXES WITH REHEAT TO SERVE TWO ATTORNEYS PER ZONE; TYPICAL.
M7	C/S PHASE; ELEC CLOSET TO BE SERVED BY SEPARATE ZONE.
M19	EXISTING DUCTWORK UP TO EXISTING AIR HANDLER TO REMAIN; NO WORK.
M20	C/S PHASE; CONNECT NEW DUCTWORK TO EXISTING SYSTEM TO REMAIN IN WORKING ORDER DURING CONSTRUCTION.
M22	C/S PHASE; TEMPERATURE CONTROL PANEL; TO BE OPERATIONAL DURING CONSTRUCTION FOR CONTROL OF NEW CONTROL DAMPERS.
M24	T/I PHASE; PROVIDE 36"X24" OPENING AT TOP OF DUCT. STIFFEN DUCT AS REQUIRED TO ELIMINATE VIBRATIONS.
M33	C/S PHASE; PROVIDE CONTROL DAMPER AT DUCT CONNECTED TO EXISTING ROOFTOP UNIT. T/I PHASE; PROVIDE DUCTWORK DOWNSTREAM DAMPER.
M38	C/S PHASE; PROVIDE MANUAL VOLUME DAMPER AND DUCTWORK UP TO EXHAUST FAN. T/I PHASE, DUCTWORK TO EXHAUST GRILLES.

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MECHANICAL PLAN - LEVEL 1

M 201

BUILDING KEYPLAN (NORTH-EAST)
NOT TO SCALE

GENERAL NOTES

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2. ROUTE NEW HVAC DUCTWORK, FROM CONNECTIONS TO EXISTING MAIN SUPPLY, RETURN AND EXHAUST DUCTWORK AT THE SECOND LEVEL ROOF, CONNECTING TO EXISTING SYSTEMS TO REMAIN, AS WELL AS CONNECTIONS TO NEW SYSTEMS INSTALLED WITHIN THIS PROJECT. DUCTWORK SHALL BE CONSTRUCTED SO THAT EXISTING SPACES SHALL NOT LOSE SERVICE TO THESE SYSTEMS.

WORK NOTES

M10	NEW RECTANGULAR MEDIUM PRESSURE SUPPLY DUCT DOWN IN NEW SHAFT.
M11	NEW RECTANGULAR LOW PRESSURE RETURN DUCT DOWN IN NEW SHAFT.
M13	PROVIDE VAV TERMINAL BOXES WITH REHEAT TO SERVE SUPPORT SPACES ON A SINGLE ZONE.
M15	PROVIDE VAV TERMINAL BOXES WITH REHEAT TO SERVE TWO ATTORNEYS PER ZONE; TYPICAL.
M17	T/I PHASE; PROVIDE AIR TERMINALS WITH REHEAT TO SERVE EACH CONFERENCE ROOM ON A SEPERATE ZONE; TYPICAL.
M24	T/I PHASE; PROVIDE 36"X24" OPENING AT TOP OF DUCT. STIFFEN DUCT AS REQUIRED TO ELIMINATE VIBRATIONS.
M25	C/S PHASE; REMOVE EXISTING DUCT DOWN THRU ROOF ABOVE ROOF LEVEL, COMPLETELY UP TO 60ø MAIN
M26	C/S PHASE; CONNECT NEW DUCTWORK TO EXISTING M.P. SUPPLY DUCT. PROVIDE CONTROL DAMPER FOR BALANCING DURING CONSTRUCTION.
M27	C/S PHASE; NEW CONTROL DAMPER AT EXISTING DUCTWORK FOR BALANCING DURING CONSTRUCTION.
M28	EXISTING DUCTWORK TO REMAIN.
M29	C/S PHASE; NEW AIRCOOLED CONDENSING UNIT CONNECTED TO FAN COIL. UNIT IN DATA ROOM. TO BE OPERATIONAL DURING CONSTRUCTION.
M33	C/S PHASE; PROVIDE CONTROL DAMPER AT DUCT CONNECTED TO EXISTING ROOFTOP UNIT. T/I PHASE; PROVIDE DUCTWORK DOWNSTREAM DAMPER.
M34	EXISTING COOLING TOWER TO REMAIN OPERATIONAL DURING CONSTRUCTION; NO WORK.
M35	EXISTING AIR HANDLER TO REMAIN OPERATIONAL DURING CONSTRUCTION; NO WORK.
M36	EXISTING EXHAUST FAN TO REMAIN OPERATIONAL DURING CONSTRUCTION; NO WORK.
M38	C/S PHASE; PROVIDE MANUAL VOLUME DAMPER AND DUCTWORK UP TO EXHAUST FAN. T/I PHASE, DUCTWORK TO EXHAUST GRILLES.
M39	C/S PHASE; ROUTE NEW DUCTWORK INTO EXISTING RETURN AIR PLENUM. PROVIDE CURB AT TOP OF PLENUM CONSTRUCTION.

MECHANICAL PLAN - LEVEL 2
1/8" = 1'-0"
4' 2' 0' 4' 8' 16'

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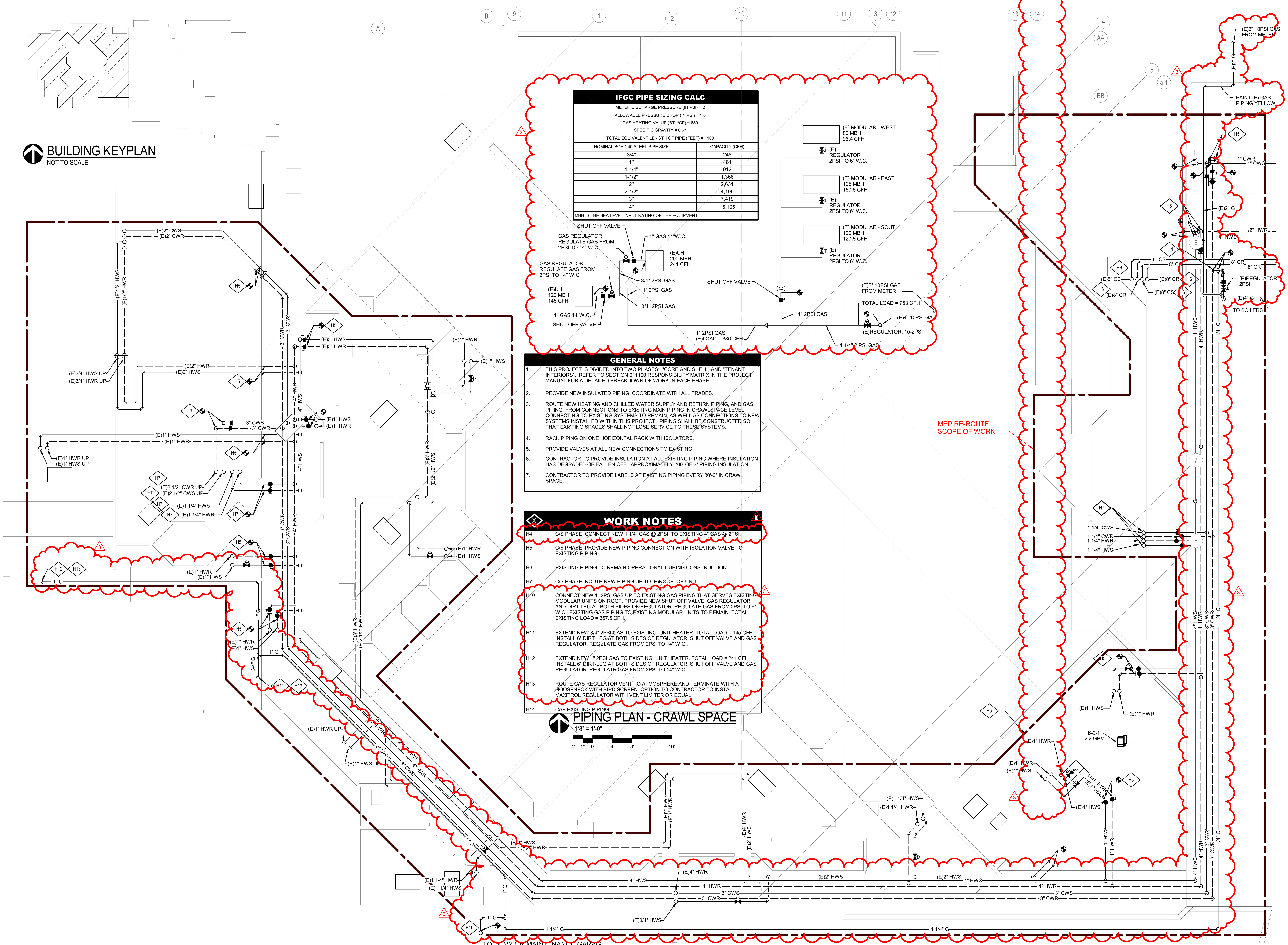
MECHANICAL PLAN - LEVEL 2

M
202

BUILDING KEYPLAN
NOT TO SCALE



IFGC PIPE SIZING CALC

METER DISCHARGE PRESSURE (IN PSI) = 2
ALLOWABLE PRESSURE DROP (IN PSI) = 1.0
GAS HEATING VALUE (BTU/CF) = 830
SPECIFIC GRAVITY = 0.67
TOTAL EQUIVALENT LENGTH OF PIPE (FEET) = 1100

NOMINAL SCHD.40 STEEL PIPE SIZE	CAPACITY (CFH)
3/4"	248
1"	461
1-1/4"	912
1-1/2"	1,368
2"	2,631
2-1/2"	4,199
3"	7,419
4"	15,105

MBH IS THE SEA LEVEL INPUT RATING OF THE EQUIPMENT

GENERAL NOTES

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2. PROVIDE NEW INSULATED PIPING. COORDINATE WITH ALL TRADES.
3. ROUTE NEW HEATING AND CHILLED WATER SUPPLY AND RETURN PIPING, AND GAS PIPING, FROM CONNECTIONS TO EXISTING MAIN PIPING IN CRAWLSPACE LEVEL, CONNECTING TO EXISTING SYSTEMS TO REMAIN, AS WELL AS CONNECTIONS TO NEW SYSTEMS INSTALLED WITHIN THIS PROJECT. PIPING SHALL BE CONSTRUCTED SO THAT EXISTING SPACES SHALL NOT LOSE SERVICE TO THESE SYSTEMS.
4. RACK PIPING ON ONE HORIZONTAL RACK WITH ISOLATORS.
5. PROVIDE VALVES AT ALL NEW CONNECTIONS TO EXISTING.
6. CONTRACTOR TO PROVIDE INSULATION AT ALL EXISTING PIPING WHERE INSULATION HAS DEGRADED OR FALLEN OFF. APPROXIMATELY 200' OF 2" PIPING INSULATION.
7. CONTRACTOR TO PROVIDE LABELS AT EXISTING PIPING EVERY 30'-0" IN CRAWL SPACE.

WORK NOTES

H4	C/S PHASE; CONNECT NEW 1 1/4" GAS @ 2PSI TO EXISTING 4" GAS @ 2PSI.
H5	C/S PHASE; PROVIDE NEW PIPING CONNECTION WITH ISOLATION VALVE TO EXISTING PIPING.
H6	EXISTING PIPING TO REMAIN OPERATIONAL DURING CONSTRUCTION.
H7	C/S PHASE; ROUTE NEW PIPING UP TO (E)ROOFTOP UNIT.
H10	CONNECT NEW 1" 2PSI GAS UP TO EXISTING GAS PIPING THAT SERVES EXISTING MODULAR UNITS ON ROOF. PROVIDE NEW SHUT OFF VALVE, GAS REGULATOR AND DIRT-LEG AT BOTH SIDES OF REGULATOR. REGULATE GAS FROM 2PSI TO 6" W.C. EXISTING GAS PIPING TO EXISTING MODULAR UNITS TO REMAIN. TOTAL EXISTING LOAD = 367.5 CFH.
H11	EXTEND NEW 3/4" 2PSI GAS TO EXISTING UNIT HEATER. TOTAL LOAD = 145 CFH. INSTALL 6" DIRT-LEG AT BOTH SIDES OF REGULATOR, SHUT OFF VALVE AND GAS REGULATOR. REGULATE GAS FROM 2PSI TO 14" W.C..
H12	EXTEND NEW 1" 2PSI GAS TO EXISTING UNIT HEATER. TOTAL LOAD = 241 CFH. INSTALL 6" DIRT-LEG AT BOTH SIDES OF REGULATOR, SHUT OFF VALVE AND GAS REGULATOR. REGULATE GAS FROM 2PSI TO 14" W.C..
H13	ROUTE GAS REGULATOR VENT TO ATMOSPHERE AND TERMINATE WITH A GOOSENECK WITH BIRD SCREEN. OPTION TO CONTRACTOR TO INSTALL MAXITROL REGULATOR WITH VENT LIMITER OR EQUAL
H14	CAP EXISTING PIPING.

PIPING PLAN - CRAWL SPACE
1/8" = 1'-0"

4' 2' 0' 4' 8' 16'

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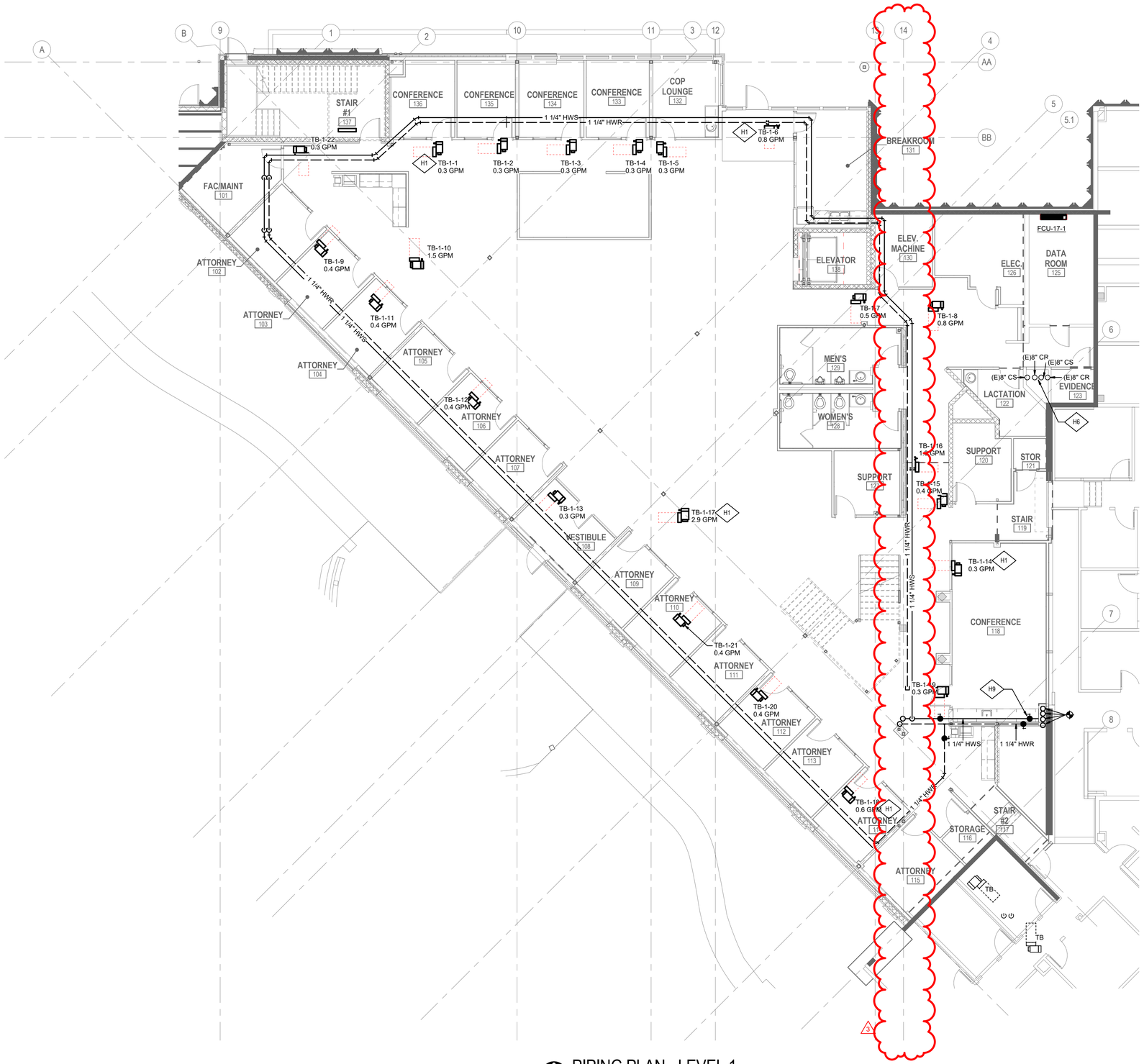
Revision Issue

Rev. #	Description	Date
1	RFI 021	05/17/18
3	PERMIT COMMENTS	06/01/2018

MECHANICAL PIPING PLAN - CRAWL SPACE

M 300



PIPING PLAN - LEVEL 1

1/8" = 1'-0"

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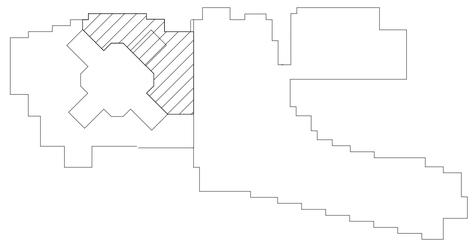

BUILDING KEYPLAN (NORTH-EAST)

NOT TO SCALE

GENERAL NOTES

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2. PROVIDE NEW INSULATED PIPING. COORDINATE WITH ALL TRADES.
3. ROUTE NEW HEATING AND CHILLED WATER SUPPLY AND RETURN PIPING, AND GAS PIPING, FROM CONNECTIONS TO EXISTING MAIN PIPING IN CRAWLSPACE LEVEL, CONNECTING TO EXISTING SYSTEMS TO REMAIN, AS WELL AS CONNECTIONS TO NEW SYSTEMS INSTALLED WITHIN THIS PROJECT. PIPING SHALL BE CONSTRUCTED SO THAT EXISTING SPACES SHALL NOT LOSE SERVICE TO THESE SYSTEMS.
4. RACK PIPING ON ONE HORIZONTAL RACK WITH ISOLATORS.
5. PROVIDE VALVES AT ALL NEW CONNECTIONS TO EXISTING.
6. CONTRACTOR TO PROVIDE INSULATION AT ALL EXISTING PIPING WHERE INSULATION HAS DEGRADED OR FALLEN OFF. APPROXIMATELY 200' OF 2" PIPING INSULATION.
7. CONTRACTOR TO PROVIDE LABELS AT EXISTING PIPING EVERY 30'-0" IN CRAWL SPACE.

WORK NOTES

H1	T/I PHASE; NEW TERMINAL BOX; REFER TO DETAIL FOR PIPING CONNECTIONS TYPICAL.
H6	EXISTING PIPING TO REMAIN OPERATIONAL DURING CONSTRUCTION.
H9	C/S PHASE; PROVIDE HWS/HWR PIPING AND CAPPED ISOLATION VALVE. T/I PHASE; PROVIDE HWS/HWR LOOP AND CONNECTIONS TO TERMINAL BOXES.

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MECHANICAL PIPING PLAN - LEVEL 1

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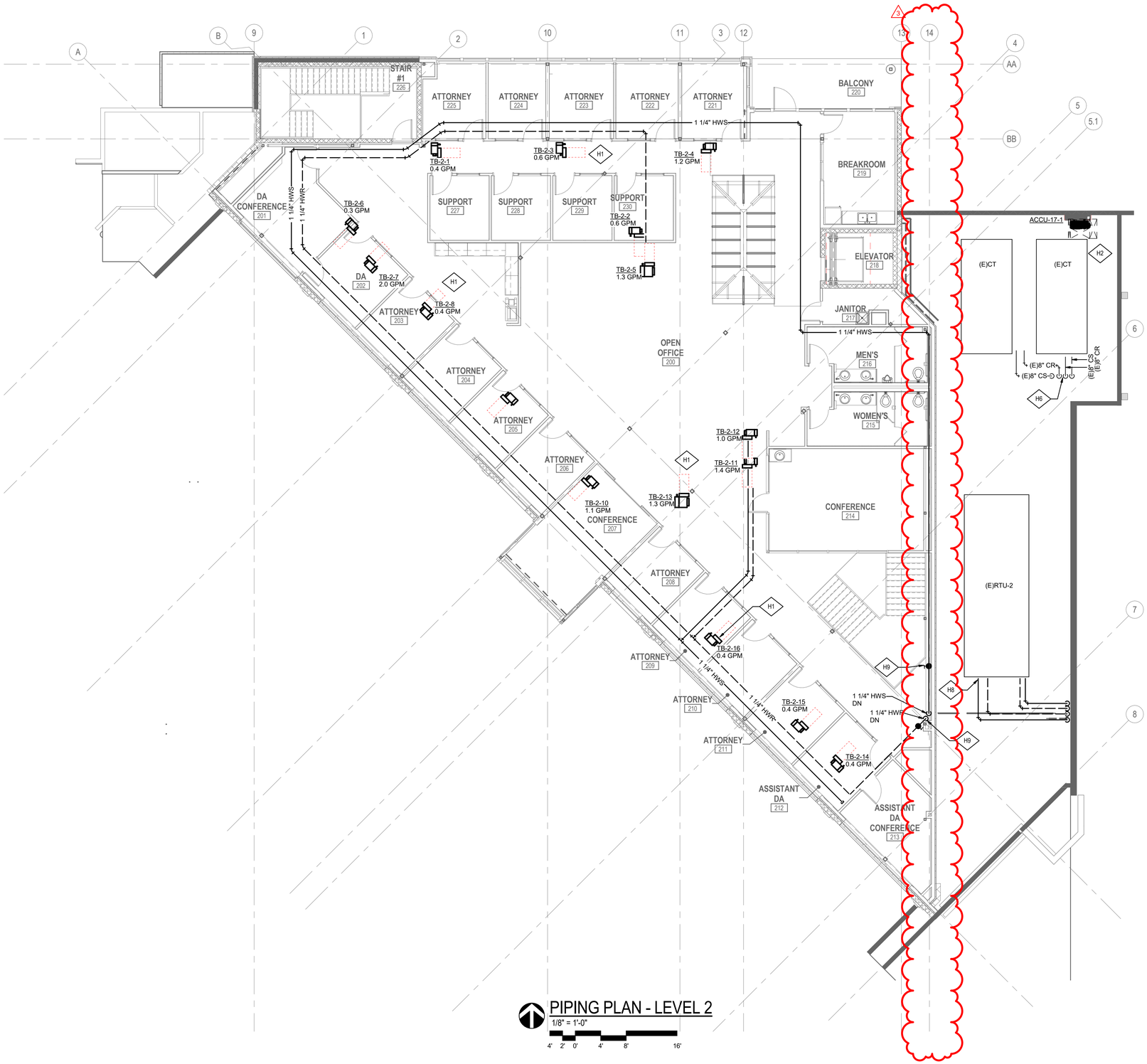
301



PIPING PLAN - LEVEL 2

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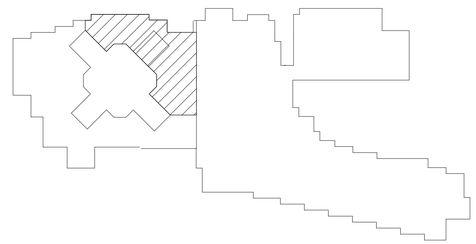

BUILDING KEYPLAN (NORTH-EAST)

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WORK NOTES

H1 T/I PHASE: NEW TERMINAL BOX; REFER TO DETAIL FOR PIPING CONNECTIONS TYPICAL.

H2 C/S PHASE; PROVIDE NEW AIR COOLED CONDENSING UNIT. INSTALL AT ROOF DURING DEMO PHASE. FCU INSTALLED IN I.T. ROOM TO REMAIN OPERATIONAL DURING CONSTRUCTION.

H6 EXISTING PIPING TO REMAIN OPERATIONAL DURING CONSTRUCTION.

H8 NEW HWS AND HWR PIPING; C/S PHASE; CONNECT TO EXISTING ROOFTOP UNIT, T/I PHASE, CONNECT TO NEW TERMINAL BOXES. NEW CWS AND CWR PIPING; C/S PHASE, CONNECT TO EXISTING ROOFTOP UNIT TO REMAIN OPERATIONAL DURING CONSTRUCTION.

H9 C/S PHASE; PROVIDE HWS/HWR PIPING AND CAPPED ISOLATION VALVE. T/I PHASE; PROVIDE HWS/HWR LOOP AND CONNECTIONS TO TERMINAL BOXES.

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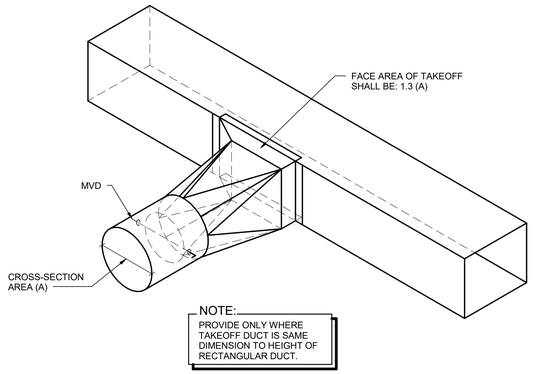
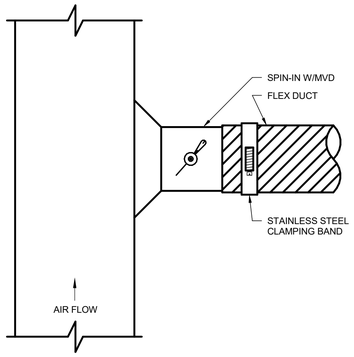
MECHANICAL PIPING PLAN - LEVEL 2

M
302



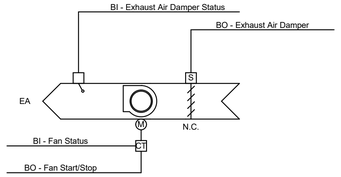
SQUARE DUCT TAKEOFF/TRANSITION DETAIL

NOT TO SCALE



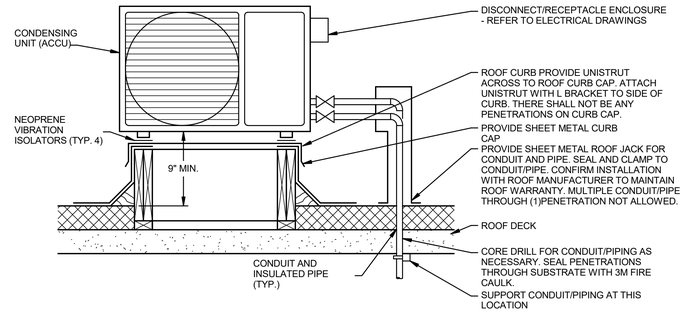
ROUND DUCT TAKE-OFF DETAIL

NOT TO SCALE



EXHAUST FAN CONTROLS DETAIL

NOT TO SCALE



CONDENSING UNIT ROOF CURB DETAIL

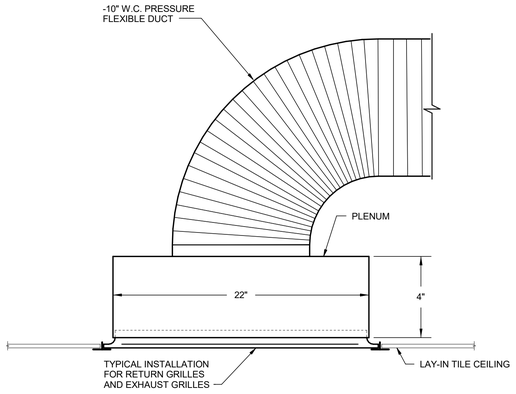
NOT TO SCALE

236200.15
3/31/2016

NOTES:

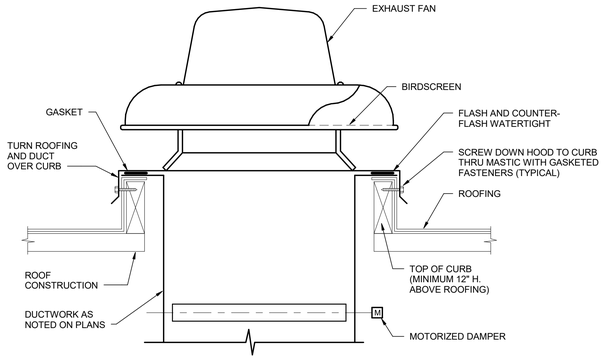
C/S PHASE; PROVIDE ACCU, FCU, PIPING, CONTROLS.

1. CONSULT WITH ROOFING MANUFACTURER BEFORE EXECUTING ANY WORK. CURB WORK SHALL NOT ADVERSELY EFFECT ANY CURRENT WARRANTY - REFER TO SPECIFICATIONS.



RETURN AND EXHAUST GRILLE CONNECTION DETAIL (DUCTED SYSTEM)

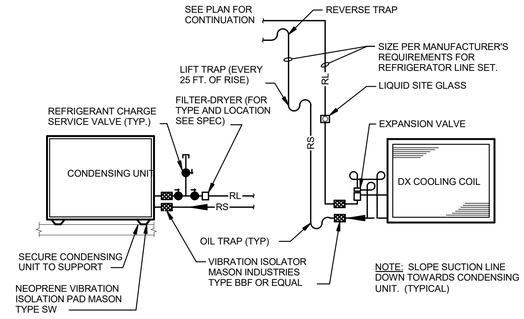
NOT TO SCALE



CENTRIFUGAL ROOF EXHAUST FAN

NOT TO SCALE

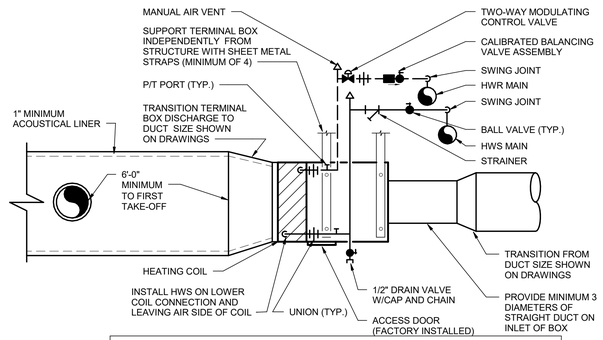
C/S PHASE; PROVIDE FAN, DUCTWORK DOWN TO MVD FOR EACH LEVEL. T/I PHASE PROVIDE DUCTWORK DOWNSTREAM MVD TO GRD'S.



REFRIGERANT PIPING DETAIL

NOT TO SCALE (< 5 TONS)

236200.08
10/12/09



C/S PHASE; NO TERMINAL BOXES OR CONNECTING DUCTWORK. T/I PHASE; PROVIDE TERMINAL BOXES, DUCTWORK, PIPING, CONTROLS.

NOTE:

1. HWS/HWR PIPING SHALL BE 3/4" UNLESS NOTED OTHERWISE ON DRAWINGS.
2. INLET DUCT SIZE TO TERMINAL BOX SHALL BE THE SAME SIZE AS INLET OF TERMINAL BOX UNLESS NOTED OTHERWISE ON DRAWINGS.
3. PROVIDE PROPER RIGHT HAND/LEFT HAND COIL CONNECTIONS TO PIPE AS SHOWN FOR MAINTAINENCNCE ACCESS. DO NOT ROTATE COIL.
4. COORDINATE AND LOCATE TERMINAL BOX IN FIELD TO PROVIDE MAINTENANCE ACCESS ON SIDE OF UNIT WITH CLEAR ACCESS TO THE FLOOR BELOW.

DESIGNER NOTES:

1. PROVIDE STRAINER PRIOR TO CONTROL VALVE ON REMODELED SYSTEMS TO AVOID PIPE SLAG/SCALE FROM CLOGGING VALVE OR PER OWNERS REQUEST.

AIR TERMINAL BOX DETAIL (2-WAY CONTROL VALVE)

NOT TO SCALE

SEQUENCE OF OPERATION:

VAV TERMINAL BOX

PROVIDE DDC CONTROLS AS FOLLOWS. INCLUDE DAT SENSOR, H.C. TCV POSITION, AND AIRFLOW CFM SETPOINT AND ACTUAL.

OCCUPIED MODE:

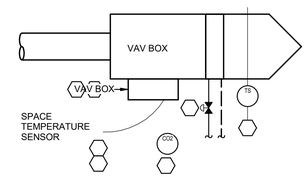
1. HEATING: WHEN SPACE TEMPERATURE FALLS BELOW THE HEATING THERMOSTAT SETPOINT MODULATE THE HEATING COIL CONTROL VALVE TOWARD THE OPEN POSITION. AS HEATING DEMAND INCREASES MODULATE THE VAV DAMPER WITH THE HEATING COIL CONTROL VALVE TOWARD THE MAX HEATING CFM (ADJ).
   a. OCCUPANCY SENSOR CONTROL: HEATING THERMOSTAT SETPOINT SHALL BE 70°F (ADJ). SETPOINT SHALL REDUCE TO 65°F (ADJ) WHEN ALL OCCUPANCY SENSORS WITHIN THE VAV ZONE INDICATE ROOMS ARE UNOCCUPIED FOR GREATER THAN 30 MIN.
   b. CO2 LEVEL CONTROL: WHERE CO2 SENSOR IS PRESENT AND THE CO2 LEVEL RISES ABOVE 1100ppm (ADJ) THE VAV BOX DAMPER SHALL MODULATE TOWARDS THE MAXIMUM HEATING CFM. MODULATE THE HEATING COIL CONTROL VALVE TO MAINTAIN SPACE TEMPERATURE SETPOINT. AN ALARM TO THE BAS SHALL BE GENERATED IF CO2 LEVEL SETPOINT IS NOT MET WITHIN 30 MIN (ADJ).
2. COOLING: WHEN SPACE TEMPERATURE RISES ABOVE THE COOLING SETPOINT MODULATE THE VAV DAMPER FROM FROM MINIMUM TO MAXIMUM COOLING CFM (ADJ). HEATING COIL CONTROL VALVE IS CLOSED.
   a. OCCUPANCY SENSOR CONTROL: COOLING THERMOSTAT SETPOINT SHALL BE 75°F (ADJ). SETPOINT SHALL INCREASE TO 80°F (ADJ) WHEN ALL OCCUPANCY SENSORS WITHIN THE VAV ZONE INDICATE ROOMS ARE UNOCCUPIED FOR GREATER THAN 30 MIN.
   b. IF CO2 SENSOR IS PRESENT AND THE CO2 LEVEL RISES ABOVE 1100ppm (ADJ) THE VAV BOX DAMPER SHALL MODULATE TOWARDS THE MAXIMUM COOLING CFM. MODULATE THE HEATING COIL CONTROL VALVE TO MAINTAIN SPACE TEMPERATURE SETPOINT. AN ALARM TO THE BAS SHALL BE GENERATED IF CO2 LEVEL SETPOINT IS NOT MET WITHIN 30 MIN (ADJ).

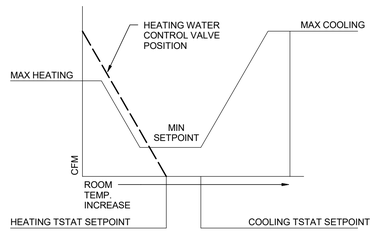
UNOCCUPIED MODE:

1. WHEN SPACE TEMPERATURE FALLS BELOW THE UNOCCUPIED HEATING THERMOSTAT SETPOINT MODULATE THE VAV DAMPER TOWARD THE MAX HEATING CFM (ADJ). HEATING COIL CONTROL VALVE SHALL BE CLOSED.

VAV BOX POINTS LIST

TAG	DESCRIPTION	TYPE





TYPICAL VAV BOX CONTROL DIAGRAM

NOT TO SCALE

SEH
Building a Better World for All of Us®

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32983
PROFESSIONAL ENGINEER
4·1·2018

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SEH Project	135948
Project Manager	JDA
Drawn By	JDA

Project Status	Issue Date
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date

MECHANICAL DETAILS

M
601

PLUMBING LEGEND

ALL SYMBOLS IN LEGEND MAY NOT NECESSARILY BE USED ON THIS PROJECT

ABBREVIATIONS AND DESCRIPTIONS

AFF	ABOVE FINISHED FLOOR
AP	ACCESS PANEL
C	COMMON
CI	CAST IRON
℄ EL.	CENTER LINE ELEVATION
CW	COLD WATER (CW)
HW	HOT WATER (HW)
HWC	HOT WATER CIRCULATING (HWC)
W	SANITARY WASTE ABOVE GRADE OR FLOOR
BD	SANITARY (BUILDING DRAIN) BELOW GRADE OR FLOOR
V	SANITARY VENT (V)
	POINT OF CONNECTION NEW TO EXISTING
	DASHED INDICATES EXISTING TO BE REMOVED

DIA, D	DIAMETER
I.E.	INVERT ELEVATION
NC	NORMALLY CLOSED
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN
SD	STORM/RAINWATER DRAIN ABOVE FLOOR OR GRADE
SD	STORM/RAINWATER DRAIN BELOW FLOOR OR GRADE
OD	OVERFLOW DRAIN ABOVE FLOOR OR GRADE
OD	OVERFLOW DRAIN BELOW FLOOR OR GRADE
S/D	PIPING TO SAND/OIL INTERCEPTOR BELOW FLOOR OR GRADE
EXISTING 4"	LIGHT LINE WEIGHT FOR EQUIPMENT, PIPING, SYMBOLS, TEXT, ETC. INDICATES EXISTING CONDITIONS WITH NEW WORK SHOWN AS DARK
NEW 4"	

TYP	TYPICAL
VCP	VITRIFIED CLAY PIPE
VTR	VENT THROUGH ROOF
SCW	SOFT COLD WATER
SHW	SOFT HOT WATER
IW	INDIRECT WASTE
GW	GREASE WASTE
NP	NON-POTABLE WATER
G	NATURAL GAS
LP	LIQUIFIED PETROLEUM GAS
CA	COMPRESSED AIR
PD	PUMP DISCHARGE
PC	PUMPED CONDENSATE
D	EQUIPMENT DRAIN
TW	TEMPERED WATER
SCS	SOLAR COLLECTOR SUPPLY
SCR	SOLAR COLLECTOR RETURN

(N)	NEW
(E)	EXISTING
(R)	RELOCATED
(F)	FUTURE
W1	WORK NOTE SYMBOL
2	REVISION SYMBOL
A	DIRECTION OF VIEW / PICTURE DESIGNATION
1 / M-7	DIRECTION OF CUT / SECTION DESIGNATION / DRAWN ON THIS SHEET

VALVES AND FITTINGS

	ELBOW UP
	ELBOW DOWN
	TEE UP
	TEE DOWN
	RISE OR DROP
	BRANCH-TOP CONNECTION
	BRANCH-BOTTOM CONNECTION
	GATE VALVE IN VERTICAL
	P-TRAP
	PIPE CAP OR PLUG
	UNION
	WALL HYDRANT WITH VACUUM BREAKER
	HOSE BIBB WITH VACUUM BREAKER
	SHOWER HEAD
	EXPANSION JOINT
	PIPE ANCHOR
	PIPE ALIGNMENT GUIDE
	FLEXIBLE CONNECTION

	STRAINER
	STRAINER W/BLOWOFF VALVE
	FLOOR SINK, (1/2" GRATE SHOWN)
	FLOOR DRAIN
	ROOF DRAIN
	OVERFLOW ROOF DRAIN
	CLEANOUT, FLOOR (FCO) OR GRADE (GCO)
	CLEANOUT, WALL (WCO)
	CLEANOUT PLUG (LCO)
	DOWNSPOUT NOZZLE
M	METER (GAS OR WATER)
	STEAM TRAP (INDICATE TYPE)
	TEMPERATURE GAUGE

	BALL VALVE
	GATE VALVE
	CALIBRATED BALANCE VALVE
	PLUG VALVE
	SOLENOID VALVE
	PRESSURE REDUCING VALVE
	CHECK VALVE
	GLOBE VALVE
	THERMOSTATIC MIXING VALVE
	BUTTERFLY VALVE
	CIRCUIT SETTER
	GAS COCK
	TEMPERATURE/PRESSURE RELIEF VALVE
	AUTOMATIC AIR VENT
	MANUAL AIR VENT

	GAS PRESSURE REGULATOR
	PRESSURE/TEMPERATURE TAP
	PRESSURE GAUGE
FS	FLOW SWITCH
PS	PRESSURE SWITCH
PI	PRESSURE INDICATOR
	WELL
	GAUGE COCK
	WATER HAMMER ARRESTER W/ BALL VALVE
T	AQUASTAT
	VACUUM BREAKER
	VALVE IN YARD BOX
	HOSE END BALL VALVE WITH VACUUM BREAKER
BFP	BACKFLOW PREVENTER

MEDICAL GAS SYMBOLS

	OXYGEN
	VACUUM
	GAS
	MEDICAL COMPRESSED AIR

	NITROGEN
	NITROUS OXIDE
W	WASTE ANESTHESIA GAS DISPOSAL ZONE VALVE BOX

N	NITROGEN
N2O	NITROUS OXIDE
OX	OXYGEN
VAC	VACUUM
MV	MEDICAL VACUUM

MA	MEDICAL COMPRESSED AIR
WAGD	WASTE ANESTHESIA GAS DISPOSAL
DV	DENTAL VACUUM
DA	DENTAL COMPRESSED AIR

LABORATORY SYMBOLS

LA	LAB COMPRESSED AIR
LG	LAB GAS (NAT. OR PROP.)
LV	LAB VACUUM
LN	LAB NITROGEN

DI	DEIONIZED WATER
DIC	DEIONIZED WATER CIRCULATING
LW	LAB WASTE ABOVE FLOOR OR GRADE

LBD	LAB BUILDING DRAIN BELOW FLOOR OR GRADE
LVT	LAB VENT

FIRE PROTECTION

	POST INDICATOR VALVE
	NON-INDICATING VALVE (NON-RISING STEM)
	OUTSIDE SCREW & YOKE VALVE (RISING STEM)
	FIRE DEPARTMENT CONNECTION
	FREE STANDING FIRE DEPARTMENT CONNECTION
	WATER FLOW SWITCH
	ALARM CHECK VALVE (HORIZONTAL OR VERTICAL)
	DRY PIPE VALVE

	DELUGE VALVE OR PREACTION VALVE
PS	PRESSURE SWITCH
	ANGLE VALVE (FIRE HOSE VALVE)
	ANGLE DRAIN VALVE AND SIGHT GLASS
	BUTTERFLY VALVE W/ TAMPER SWITCH
	OUTSIDE LIGHT AND HORN
	TAMPER SWITCH
	FIRE HOSE RACK

	SUCTION MAIN OR FIRE LINE LEAD-IN
W	PUBLIC WATER MAIN
F	FIRE
SP	FIRE SPRINKLER
FSP	FIRE STANDPIPE
DFSP	DRY FIRE STANDPIPE
ASD	AUTOMATIC FIRE SPRINKLER SYSTEM DRAIN
	NEW SPRINKLER HEAD
E	EXISTING SPRINKLER HEAD
	SIDEWALL SPRINKLER HEAD

	FIRE HOSE VALVE CABINET (SURFACE MOUNTED)
	FIRE HOSE VALVE CABINET (RECESSED)
F XX	FIRE STANDPIPE DESIGNATION
SP XX	FIRE SPRINKLER RISER DESIGNATION

PLUMBING GENERAL NOTES

1. DRAWINGS AND SPECIFICATIONS ARE COMPLIMENTARY. WHATEVER IS CALLED FOR IN EITHER IS BINDING AS THOUGH CALLED FOR IN BOTH.
2. THE EQUIPMENT SPECIFIED ON THE DRAWINGS HAVE BEEN SELECTED AS THE BASIS DESIGN. THE USE OF REVIEWED OR SPECIFIED EQUALS SHALL BE COORDINATED BY THE CONTRACTOR FOR SPACE REQUIREMENTS, EQUIPMENT DIMENSIONS AND PERFORMANCE.
3. DRAWINGS ARE DIAGRAMMATIC AND SHOW THE GENERAL DESIGN INTENT, ARRANGEMENT AND EXTENT OF SYSTEMS. DO NOT SCALE DRAWINGS NOR USE AS SHOP DRAWINGS. WHERE ALTERNATE ROUTING, OFFSETS AND TRANSITIONS ARE REQUIRED FOR FIELD COORDINATION OF ALL TRADES, THIS CONTRACTOR SHALL MAKE CHANGES WITHOUT ADDITIONAL COSTS.
4. CONTRACTOR SHALL NOT SHUT-OFF/PUT OUT OF SERVICE ANY SYSTEMS/SERVICES WITHOUT FIRST COORDINATING ALL DOWNTIME WITH OWNER'S PERSONNEL. CONTRACTOR SHALL PROVIDE A DETAILED M.O.P. AS REQUIRED. DO NOT BEGIN WORK WITHOUT WRITTEN APPROVAL.
5. ALL EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS UNLESS SPECIFICALLY DIRECTED OTHERWISE.
6. CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATION AND INSTALLING SLEEVES, INSERTS AND SUPPORTS AS REQUIRED FOR THIS SCOPE OF WORK AND/OR CORE DRILL REQUIREMENTS. COORDINATE WITH GENERAL CONTRACTOR AND STRUCTURAL ENGINEER AS REQUIRED.
7. CONTRACTOR SHALL CLOSELY COORDINATE NEW PLUMBING WITH ALL NEW AND EXISTING MECHANICAL, PLUMBING, ELECTRICAL, FIRE PROTECTION, ARCHITECTURAL AND STRUCTURAL MEMBERS. REFER TO DIVISION 22 FOR CEILING SPACE ALLOCATION PRIORITIES.
8. CONTRACTOR SHALL FIELD VERIFY ALL PLUMBING ITEMS PRIOR TO SUBMITTING A BID. NO ADDITIONAL COST WILL BE ALLOWED FOR CONTRACTOR'S FAILURE TO BECOME FAMILIAR WITH ALL EXISTING CONDITIONS.
9. ALL PLUMBING SYSTEMS SHALL BE INSTALLED IN ACCORDANCE WITH THE 2012 INTERNATIONAL BUILDING CODE, 2012 INTERNATIONAL FIRE CODE OR NFPA, 2012 INTERNATIONAL MECHANICAL CODE, AND 2012 INTERNATIONAL PLUMBING CODE AND 2012 INTERNATIONAL ENERGY CONSERVATION CODE; INCLUDING BOULDER AMENDMENTS. REFER TO ARCHITECTURAL CODE PLAN.
10. CONTRACTOR SHALL PROVIDE SUBMITTALS ON ITEMS LISTED IN THE PLUMBING SCHEDULES AND AS REQUIRED IN EACH SECTION OF SPECIFICATION TO THE ENGINEER FOR REVIEW PRIOR TO THE ORDER, PURCHASE OR INSTALLATION OF THESE SAME ITEMS.
11. NATURAL GAS INPUTS ARE AT SEA LEVEL.
12. ALL EXISTING EQUIPMENT TO BE REMOVED SHALL HAVE ALL RELATED HOUSEKEEPING PADS, PIPING, CONTROLS, GAUGES, ELECTRICAL SERVICE, HANGERS, SUPPORTS AND ANY MISCELLANEOUS RELATED SERVICE OR PARTS...
13. PROVIDE WATER HAMMER ARRESTERS AT ALL QUICK CLOSING VALVES WITH ISOLATION VALVE AND WITH ACCESS OR ACCESS PANEL.
14. ALL THREADED HOSE CONNECTIONS TO DOMESTIC WATER SYSTEM SHALL HAVE AN APPROVED VACUUM BREAKER. IE: HOSE BIBBS, WALL HYDRANTS, SYSTEM DRAINS, EQUIPMENT DRAINS, ETC.
15. PROVIDE BALANCE OF DOMESTIC WATER CIRC LINES TO GPM INDICATED ON...
16. IT IS THE PLUMBING CONTRACTORS RESPONSIBILITY TO PROVIDE BACKFLOW PREVENTION AS REQUIRED BY CODE TO ALL PLUMBING, MECHANICAL EQUIPMENT AND IRRIGATION, INCLUDING BUT NOT LIMITED TO COFFEE MAKERS, JUICE MACHINES, TEA BREWERS, ICE MAKERS, LABORATORY HOODS, ETC.
17. PROVIDE REDLINE MARKUPS OF ANY FIELD CHANGES OR MODIFICATIONS ON THE CONSTRUCTION DOCUMENTS. REDLINE DRAWINGS SHALL BE REQUIRED WHETHER COORDINATION DRAWINGS ARE REQUIRED OR NOT.
18. EQUIPMENT E.E.R. AND/OR C.O.P. SHALL COMPLY WITH ASHRAE 90.1.
19. EXISTING EQUIPMENT AS NOTED ON DRAWINGS SHALL BE RETURNED TO THE OWNER AT THEIR DESIGNATED LOCATION.

PLUMBING NARRATIVE

THIS PROJECT CONSISTS OF THE REMOVAL OF A PORTION OF THE EXISTING BUILDING IN IT'S ENTIRITY AND THE CONSTRUCTION OF NEW ADDITION. THE PLUMBING UTILITIES SHALL BE EXTENDED FROM THE EXISTING BUILDING TO SERVE THE NEW ADDITION. CONNECT NEW PIPING TO PIPING CONSTRUCTED IN THE MEP RE-ROUTE PORTION OF THIS PROJECT.

PLUMBING DRAWING LIST

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Building a Better World for All of Us®

COLORADO LICENSED
REGISTERED
32983
PROFESSIONAL ENGINEER
6·1·2018

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SEH Project	135948
Project Manager	JDA
Drawn By	REG
Project Status	**Issue Date**
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date

PLUMBING GENERAL INFORMATION

P
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PLUMBING FIXTURE SCHEDULE

PLAN CODE	DESCRIPTION	LOCATION	FIXTURE MFGR.	FIXTURE MODEL	FIXTURE MOUNTING STYLE	FIXTURE INSTALLED		FLUSH VALVE MFGR.	FLUSH VALVE MODEL	FIXTURE INSTALLED		FLUSH VALVE STYLE	FAUCET MFGR.	FAUCET MODEL	FAUCET INSTALLED		FAUCET STYLE	GPF/GPM	FIXTURE MOUNTING HEIGHT A.F.F.	REMARKS
						FIXTURE MFGR.	FIXTURE MODEL			FLUSH VALVE MFGR.	FLUSH VALVE MODEL				FAUCET MFGR.	FAUCET MODEL				
WC-1	WATER CLOSET - STANDARD - SENSOR FLUSH VALVE - BATTERY	PUBLIC TOILET ROOMS	AMERICAN STANDARD	2257.101	WALL	NA	NA	SLOAN	111-1.28	NA	NA	SENSOR	NA	NA	NA	NA	NA	1.28	STANDARD	(7)
WC-2	WATER CLOSET - ADA - SENSOR FLUSH VALVE - BATTERY	PUBLIC TOILET ROOMS	AMERICAN STANDARD	2257.101	WALL	NA	NA	SLOAN	111-1.28	NA	NA	SENSOR	NA	NA	NA	NA	NA	1.28	17-19" TO TOP OF SEAT	(7)
UR-1	URINAL - STANDARD - SENSOR FLUSH VALVE - BATTERY	PUBLIC TOILET ROOMS	AMERICAN STANDARD	6590.001EC	WALL	NA	NA	SLOAN	ECOS 8186-0.25	NA	NA	SENSOR	NA	NA	NA	NA	NA	0.25	STANDARD	(7)
UR-2	URINAL - ADA - SENSOR FLUSH VALVE - BATTERY	PUBLIC TOILET ROOMS	AMERICAN STANDARD	6590.001EC	WALL	NA	NA	SLOAN	ECOS 8186-0.25	NA	NA	SENSOR	NA	NA	NA	NA	NA	0.25	15-1/4" - TOP OF RIM	(7)
L-1	LAVATORY - OVAL - ADA	PUBLIC TOILET ROOMS	AMERICAN STANDARD	0476.028	COUNTER	NA	NA	NA	NA	NA	NA	NA	CHICAGO	2200-4E2805ABCP	NA	NA	SINGLE LEVER	0.5	ADA-RE: ARCH DWGS	(5) (6) (14) (17) 4" CENTERS
S-1	STAINLESS STEEL SINK	VARIOUS LOCATIONS	ELKAY	ECTSRS33229BG	COUNTER	NA	NA	NA	NA	NA	NA	NA	CHICAGO	786-E35XKABCP			WRIST BLADES	1.5		8"CENTERS
S-2	STAINLESS STEEL SINK - DOUBLE	BREAK ROOM	AMERICAN STANDARD	24SB.151511.290	COUNTER	NA	NA	NA	NA	NA	NA	NA	CHICAGO	350-E35VP317XKABCP	NA	NA	WRIST BLADES	1.5		(11) ONE-HOLE PUNCH
GD-1	GARBAGE DISPOSER	BREAK ROOM SINK	IN-SINK-ERATOR	EVOLUTION ESSENTIAL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA			(10)
MSB-1	MOP SERVICE BASIN - TERRAZZO	JANITOR CLOSET	ACORN	TSH-24-KF24	FLOOR	NA	NA	NA	NA	NA	NA	NA	CHICAGO	814-VBCP	NA	NA	LEVER			(5)
EWC-1	ELECTRIC WATER COOLER	RESTROOMS	ELKAY	EZSTL8WS	WALL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA			(15) (16) PROVIDE WALL MOUNTING SUPPORT
FD-1	FLOOR DRAIN	FINISHED AREAS	J.R. SMITH	2005-A06NB	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA			(1) (8)
TS-1	TRAP SEAL (VERIFY USE WITH AHJ)	VARIOUS LOCATIONS	SURE SEAL	VARIES BY SIZE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA			
RD-1	ROOF DRAIN	NA	J.R. SMITH	1010	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA			(3)
OFD-1	OVERFLOW ROOF DRAIN	NA	J.R. SMITH	1070	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA			(3) PROVIDE 2" STANDPIPE
DSN-1	DOWNSPOUT NOZZLE	NA	J.R. SMITH	1770	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA			
WH-1	WALL HYDRANT	EXTERIOR LOCATIONS	NA	NA	WALL	NA	NA	NA	NA	NA	NA	NA	WOODFORD	B67	NA	NA	LOOSE KEY		RE: ARCH DWGS	
HB-1	HOSE BIBB - COLD ONLY	RESTROOM & VARIOUS LOCATIONS	NA	NA	WALL	NA	NA	NA	NA	NA	NA	NA	CHICAGO	952-CP	NA	NA	LOOSE KEY		RE: ARCH DWGS	
WB-1	ICE MACHINE WALL BOX	BREAK ROOM	GUY GRAY	BIM875-AB	WALL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA			

GENERAL FIXTURE NOTES

1. ALL WATER CLOSETS TO HAVE ELONGATED OPEN FRONT SEAT WITH SELF SUSTAINING CHECK HINGES, WHITE BENEKE NO. 523-SS UNLESS NOTED OTHERWISE.
2. ALL FLOOR DRAINS AND FLOOR SINKS TO HAVE FLASHING COLLAR. COORDINATE FLASHING MEMBRANE WITH SPECIFICATIONS.
3. ALL GOOSENECK SPOUTS TO SWIVEL.
4. SLOAN FLUSH VALVES ARE TO BE ROYAL MODELS.
5. FLOOR DRAINS TO HAVE TRAP PRIMERS.

(1) PROVIDE WITH TRAP PRIMER CONNECTION. ON DRAWINGS WHERE TRAP PRIMERS ARE NOT INDICATED ORDER DRAIN WITHOUT CONNECTION.

(2) PROVIDE WITH ARC 3/4 GRATE, ARC COATED INTERIOR.

(3) PROVIDE WITH CAST IRON DOME STRAINER, UNDERDECK CLAMP.

(4) PROVIDE WITH WRIST BLADE HANDLES, GOOSENECK SPOUT, FLOW CONTROL (NO AERATION IN WATER STREAM).

(5) PROVIDE OPEN GRID STRAINER.

(6) PROVIDE TRUEBRO INSULATION KIT ON ALL EXPOSED PIPING.

(7) PROVIDE COMMERCIAL GRADE CARRIER WITH FEET SECURELY BOLTED TO THE FLOOR AND ALL FIXTURE MOUNTING ACCESSORIES.

(8) ROUND NICKEL BRONZE STRAINER.

(9) PROVIDE WITH SEDIMENT BUCKET.

(10) PROVIDE WITH CORD AND PLUG.

(11) PROVIDE CRUMB STRAINER.

(12) PROVIDE WITH BOTTOM DOME STRANER.

(13) PROVIDE 20 GPM FLOW RESRICTOR.

(14) PROVIDE WITH 0.5 GPM AERATOR.

(15) PROVIDE ELECTRICAL PLIG-IN RECEPTACLE.

(16) PROVIDE AN IN-LINE WATER FILTER AFTER ISOLATION VALVE AND BEFORE WATER COOLER, AQUA PURE MODEL AP500. LOCATE SO CARTRIDGE IS ACCESSIBLE FOR SERVICING.

(17) PROVIDE TRANSFORMER WITH FAUCET. ONE TRANSFORMER CAN OPERATE UP TO 3 SENSOR FAUCETS.

(18) PROVIDE SLOAN TRANSFORMER MODEL EL-154. ONE TRANSFORMER CAN OPERATE UP TO 10 FLUSH VALVES.

(19) PROVIDE LEAD-FREE VALVES WITH SHOCK ARRESTERS.

(20) PROVIDE TRIP LEVER TO WIDE SIDE OF STALL.

(21) PROVIDE FLUSH VALVE HANDLE TO WIDE SIDE OF STALL.

ELEVATOR SUMP PUMP SCHEDULE

PLAN CODE	MFR.	MODEL	INSTALLED		CAPACITY GPM	HEAD FT. WATER	MOTOR		REMARKS
			MFR.	MODEL			HP	VOLTS/PH	
SP-1	STANCOR	SE-100			50	25	1	115/1	(1)

(1) PROVIDE SIMPLEX PUMP SYSTEM, CONTROL PANEL WITH EXTRA SET OF DRY CONTACTS FOR CONNECTIONS TO BAS. PROVIDE HIGH WATER ALARM (AUDIBLE) AND LIGHT. PROVIDE 2 FLOAT SYSTEM. ALL COMPONENTS TO BE COMPATIBLE.

(2) VERIFY WITH LOCAL AUTHORITY THAT OIL DETECTION IS ACCEPTABLE AND IF SO, IF PUMP SHOULD NOT TURN OFF UPON OIL DETECTION BUT REMAIN OPERATIONAL.

PLUMBING FIXTURE CONNECTION SCHEDULE

FIXTURE TYPE	SYMBOL	MIN TRAP SIZE	SOIL OR WASTE	VENT (1)	COLD WATER	HOT WATER	REMARKS
WATER CLOSET (FLUSH VALVE)	WC	--	4"	2"	1"	--	(3)(4)
URINAL	UR	--	2"	2"	3/4"	--	(3)
LAVATORY	L	1-1/4"	2"	2"	1/2"	1/2"	(2)
SINK	S	1-1/2"	2"	2"	1/2"	1/2"	
MOP SERVICE BASIN	MSB	3"	3"	2"	1/2"	1/2"	
WATER COOLER / DRINKING FOUNTAIN	EWC/DF	1-1/4"	2"	2"	1/2"	--	(2)

(1) 2" MINIMUM VENT BELOW GRADE.

(2) 2" MINIMUM WASTE BELOW GRADE.

(3) PROVIDE SHOCK ARRESTOR ON COLD WATER SUPPLY W/ ACCESS DOOR.

(4) ADA ACCESSIBLE W.C. - LOCATE FLUSH VALVE HANDLE ON WIDE SIDE OF STALL. HANDLE SHALL MEET ADA REQUIREMENTS.

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32983
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11-1-2018

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JUSTICE CENTER DA INFILL

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SEH Project	135948
Project Manager	JDA
Drawn By	REG
Project Status	**Issue Date**
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date
1	Addendum 1	2017-12-01

PLUMBING SCHEDULES

P
002

Commercial (Service Hot Water ONLY)
Prescriptive Measures Checklist

2017
City of Boulder
Energy Conservation Code

Applies to: New Buildings and Additions with a construction valuation of <$500,000; Alterations and Repairs are determined by construction valuations and should refer to Table C401.2.2.

Project Address: Date: 1/23/2018

DIRECTIONS: Compliance with these measures is required if the project uses the Prescriptive Compliance Path. Please complete this checklist and include it on an "Energy Conservation Code" sheet within the plans being submitted for permit application. Projects complying prescriptively also must meet Mandatory Measures and should include the Mandatory Measures Checklist as well.

Code Section	Focus Area	Code Description			Plan Drawing or Reference # to demonstrate compliance (N/A if not applicable)	Submitter Notes (e.g. If "N/A" Please explain why requirement does not apply or is not demonstrated on plans/specs)	Plans Examiner Notes (in office use)
SERVICE WATER HEATING							
	Equipment	**Size Category (Input)**	**Subcategory/ Rating Condition**	**Required Performance**			
C404.2	Water heaters, electric	>12kW	Resistance >20 gal	0.3 + 27/Vm %h		This remodel project connected to the existing domestic hot water service with recirculation to remain. 24 lavatories and 4 showers were removed with 6 lavatories, 6 sinks and 1 mop basin added for the remodel.	☐ Field Verify
	Gas storage water heaters	>75,000 Btu/h	<4000 (Btu/h)/gal	80% E_t		This remodel project connected to the existing domestic hot water service with recirculation to remain. 24 lavatories and 4 showers were removed with 6 lavatories, 6 sinks and 1 mop basin added for the remodel.	☐ Field Verify
	Gas Instantaneous	≥200,000 Btu/h	≥ 4000 (Btu/h)/gal and <10gal	80% E_t		This remodel project connected to the existing domestic hot water service with recirculation to remain. 24 lavatories and 4 showers were removed with 6 lavatories, 6 sinks and 1 mop basin added for the remodel.	☐ Field Verify
		≥200,000 Btu/h	≥ 4000 (Btu/h)/gal and >10gal	80% E_t (Q/800 + 110√V)SL, Btu/h			
	Oil storage or instantaneous			Not Permitted		NA - Not permitted	☐ Field Verify
	Hot water supply boilers, gas and oil	≥300,000 Btu/h and < 12,500,000 Btu/h	≥ 4,000 Btu/h/gal and < 10 gal	80% E_t (Q/800 + 110√V)SL, Btu/h		NA	☐ Field Verify
	Hot water supply boilers, gas		≥ 4,000 Btu/h/gal and ≥ 10 gal			NA	☐ Field Verify
	Hot water supply boilers, oil		> 4,000 Btu/h/gal and > 10 gal	78% E_t (Q/800 + 110√V)SL, Btu/h		NA	☐ Field Verify
	Pool heaters, gas and oil	All		82% E_t		NA - No pool	☐ Field Verify
	Heat pump pool heaters	All	50°F db 44°F wb Outdoor Air 80°F entering water	4.0 COP		NA - No pool	☐ Field Verify
	Unfired storage tanks	All		Minimum insulation R-12.5		NA - No pool	☐ Field Verify

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SEH Project 135948
Project Manager JDA
Drawn By REG

Project Status **Issue Date**

Revision Issue

Rev. #	Description	Date

ENERGY CONSERVATION CODE

P
003

Commercial (Service Hot Water ONLY) Mandatory Measures Checklist

Applies to: All New Buildings, Additions, Alterations and Repairs which require a permit from the City.

2017
City of Boulder
Energy Conservation Code

Project Address:

Date:

DIRECTIONS: Compliance with these Mandatory Measures is required whether the project is demonstrating compliance through the Performance or Prescriptive Path. Please complete this checklist and include it on an "Energy Conservation Code" sheet within the plans being submitted for permit application.

Code Section	Focus Area	Code Description	Plan Drawing or Reference # to demonstrate compliance (N/A if not applicable)	Submitter Notes (e.g. If "N/A" Please explain why requirement does not apply or is not demonstrated on plans/specs)	Plans Examiner Notes (in office use)
SERVICE WATER HEATING					
C404.3	Temperature Controls	Service water-heating equipment shall be provided with controls to allow a setpoint of 110°F (43°C) for equipment serving dwelling units and 90°F (32°C) for equipment serving other occupancies. The outlet temperature of lavatories in public facility rest rooms shall be limited to 110°F (43°C).		This remodel project connected to the exisitng domestic hot water system to remain serving the entire building. Lavatories shall be tempered to 110°F at each lavatory using ASSE 1070 thermostatic mixing valves.	☐ Field Verify
C404.4	Heat Traps	Water heating equipment not supplied with integral heat traps and servicing noncirculating systems shall be provided with heat traps on supply and discharge pipingt associated with the equipment.		This remodel project connected to the exisitng domestic hot water system to remain serving the entire building.	☐ Field Verify
C404.5	Piping Insulation	For automatic-circulating hot water and heat-traced systems, piping shall be insulated with not less than 1 inch of insulation having a conductivity not exceeding 0.27 Btu per inch/h × ft2 × °F. The first 8 feet of piping in non-hot-water-supply temperature maintenance systems served by equipment without integral heat traps shall be insulated with 0.5 inch of material having a conductivity not exceeding 0.27 Btu per inch/h × ft2 × °F.		This remodel project connected to the exisitng domestic hot water system piping to remain serving the entire building. Remodel area will comply.	☐ Field Verify
C404.6	Temperature Maintenance Controls / Hot water system controls	Systems designed to maintain usage temperatures in hot-water pipes, such as recirculating hot-water systems or heat trace, shall be equipped with automatic time switches or other controls that can be set to switch off the usage temperature maintenance system during extended periods when hot water is not required.		This remodel project connected to the exisitng domestic hot water system to remain serving the entire building.	☐ Field Verify
C404.7.1	Pool Heaters	Pool heaters shall be equipped with a readily accessible on/off switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas shall not have continuously burning pilot lights.		NA - No pool	☐ Field Verify
C404.7.2	Pool Time Switches	Time switches shall be installed on swimming pool heaters and pumps.		NA - No pool	☐ Field Verify
C404.7.3	Pool Covers	Heated pools shall be equipped with a vapor retardant pool cover on or at the water surface. Pools heated to more than 90°F shall have a pool cover with a minimum insulation value of R-12.		NA - No pool	☐ Field Verify

SYSTEM COMMISSIONING					
C407.2	Mechanical System Commissioning and Completion Requirements	Prior to passing the final mechanical inspection, the registered design professional shall provide evidence of mechanical systems commissioning and completion in accordance the provisions of this section.		Prior to passing the final mechanical inspection, the registered design professional will provide evidence of mechanical systems commissioning and completion in accordance the provisions of this section.	Documentation Required [ ] Commissioning Report [ ] System Balancing Report

Code Section	Focus Area	Code Description	Plan Drawing or Reference # to demonstrate compliance (N/A if not applicable)	Submitter Notes (e.g. If "N/A" Please explain why requirement does not apply or is not demonstrated on plans/specs)	Plans Examiner Notes (in office use)
ADDITIONAL SUSTAINABILITY MEASURES					
IPC Table 604.4	Water Efficiency	Revised plumbing code fixture flow rates: Lavatory, private 1.5 gpm at 60 psi Lavatory, public (metering) 0.25 gallon per metering cycle Lavatory, public (no metering) 0.5 gpm at 60 psi Shower head 2.0 gpm at 80 psi Sink Faucet 1.5 gpm at 60 psi Urinal 1.0 gallon per flushing cycle Water Closet 1.28 gallons per flushing cycle		Revised plumbing code fixture flow rates: N/A Lavatory, private 1.5 gpm at 60 psi N/A Lavatory, public (metering) 0.25 gallon per metering cycle Lavatory, public (no metering) 0.5 gpm at 60 psi N/A Shower head 2.0 gpm at 80 psi Sink Faucet 1.5 gpm at 60 psi Urinal 0.25 gallon per flushing cycle Water Closet 1.28 gallons per flushing cycle	☐ Field Verify

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SEH Project	135948
Project Manager	JDA
Drawn By	REG
Project Status	**Issue Date**

Revision Issue

Rev. #	Description	Date

ENERGY CONSERVATION CODE

P
004

GENERAL NOTES

1. THIS PROJECT IS DIVIDED INTO TWO PHASES: "CORE AND SHELL" AND "TENANT INTERIORS". REFER TO SECTION 011100 RESPONSIBILITY MATRIX IN THE PROJECT MANUAL FOR A DETAILED BREAKDOWN OF WORK IN EACH PHASE.
2. REMOVE EQUIPMENT, PIPING, CONTROLS AND SUPPORTS AS SHOWN.

WORK NOTES

WR2	REMOVE PIPING AND ALL ASSOCIATED HANGERS, SUPPORTS, ETC. AS INDICATED BY DASHED LINETYPE.
WR3	REMOVE PIPING TO LEVELS ABOVE.
WR6	CAP WASTE/STORM PIPING AS INDICATED.

PLUMBING REMOVAL PLAN - CRAWLSPACE & LOWER LEVEL

1/8" = 1'-0"

4' 2' 0' 4' 8' 16'

BUILDING KEYPLAN

NOT TO SCALE

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SEH Project	135948
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Drawn By	REG

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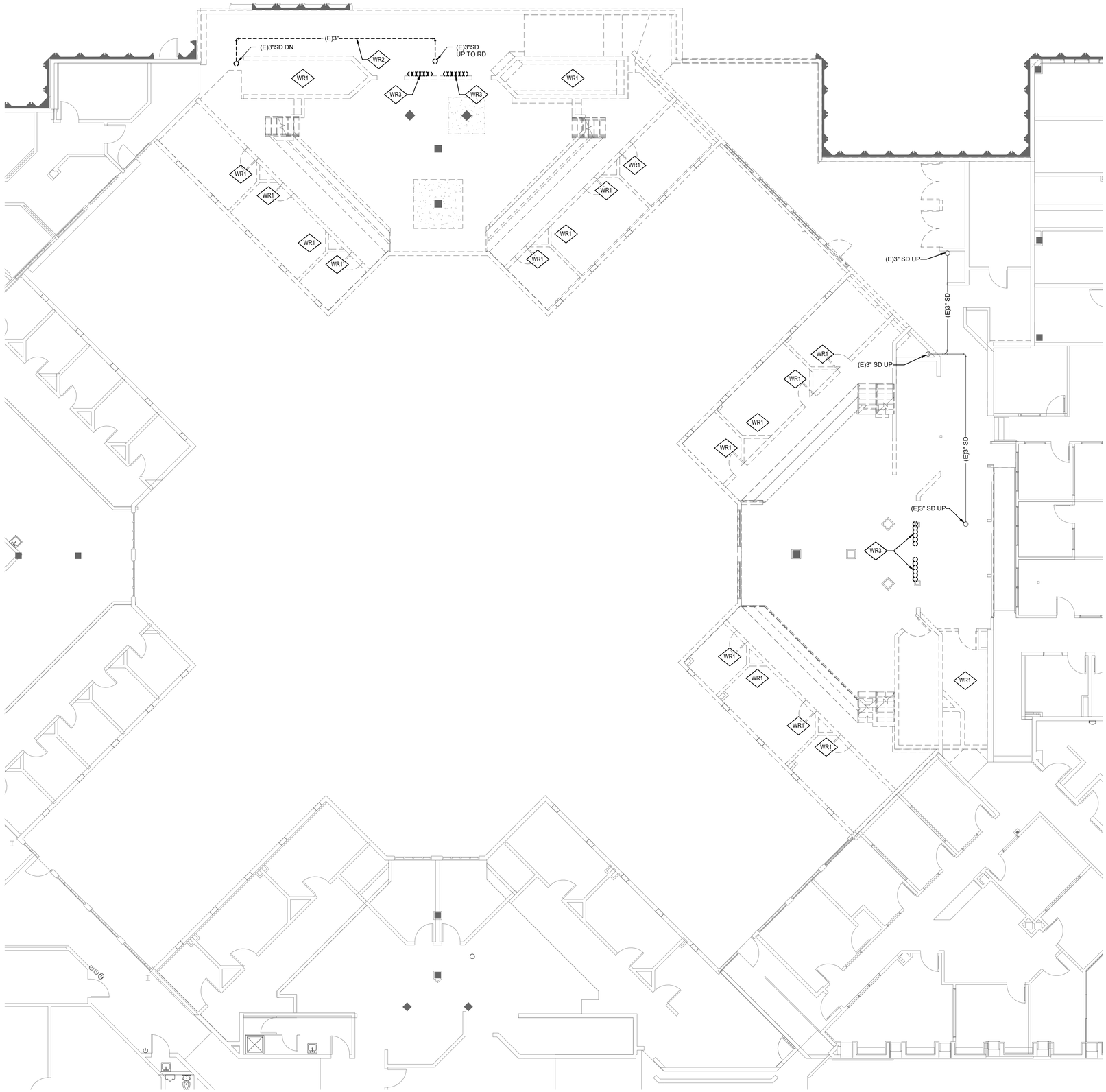
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date
1	Addendum 1	2017-12-01

PLUMBING REMOVAL PLAN - CRAWLSPACE & LOWER LEVEL

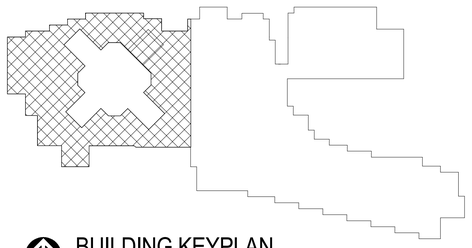
P
070



PLUMBING REMOVAL PLAN - LEVEL 1

1/8" = 1'-0"

4' 2" 0' 4" 8" 16'



BUILDING KEYPLAN

NOT TO SCALE

GENERAL NOTES

1. THIS PROJECT IS DIVIDED INTO TWO PHASES: "CORE AND SHELL" AND "TENANT INTERIORS". REFER TO SECTION 011100 RESPONSIBILITY MATRIX IN THE PROJECT MANUAL FOR A DETAILED BREAKDOWN OF WORK IN EACH PHASE.

WORK NOTES

WR1	REMOVE ALL FIXTURES, PIPING, CARRIERS, SUPPORTS, HANGERS. ETC. IN THIS AREA IN THEIR ENTIRETY.
WR2	REMOVE PIPING AND ALL ASSOCIATED HANGERS, SUPPORTS, ETC. AS INDICATED BY DASHED LINETYPE.
WR3	REMOVE PIPING TO LEVELS ABOVE.

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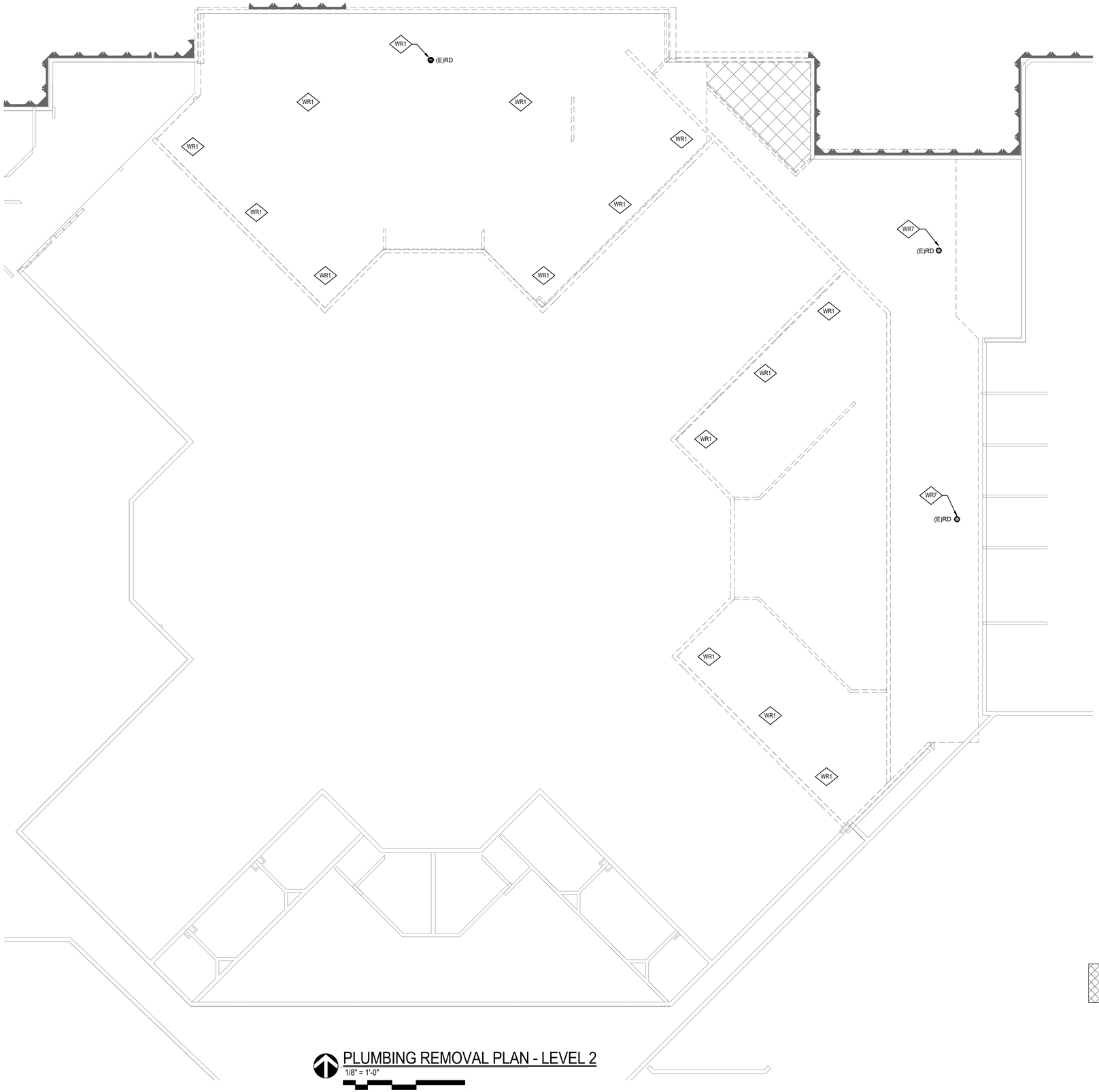
PLUMBING REMOVAL PLAN - LEVEL 1

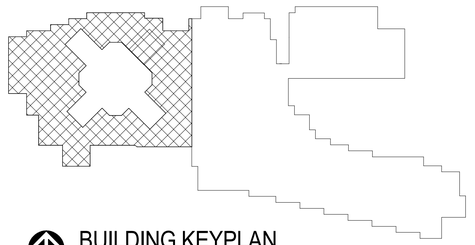
P
071



PLUMBING REMOVAL PLAN - LEVEL 2

1/8" = 1'-0"

4' 2' 0' 4' 8' 16'



BUILDING KEYPLAN

NOT TO SCALE

GENERAL NOTES

1. THIS PROJECT IS DIVIDED INTO TWO PHASES: "CORE AND SHELL" AND "TENANT INTERIORS". REFER TO SECTION 011100 RESPONSIBILITY MATRIX IN THE PROJECT MANUAL FOR A DETAILED BREAKDOWN OF WORK IN EACH PHASE.

WORK NOTES

WR1	REMOVE ALL FIXTURES, PIPING, CARRIERS, SUPPORTS, HANGERS. ETC. IN THIS AREA IN THEIR ENTIRETY.
WR7	FIXTURE TO REMAIN.

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PLUMBING REMOVAL PLAN - LEVEL 2

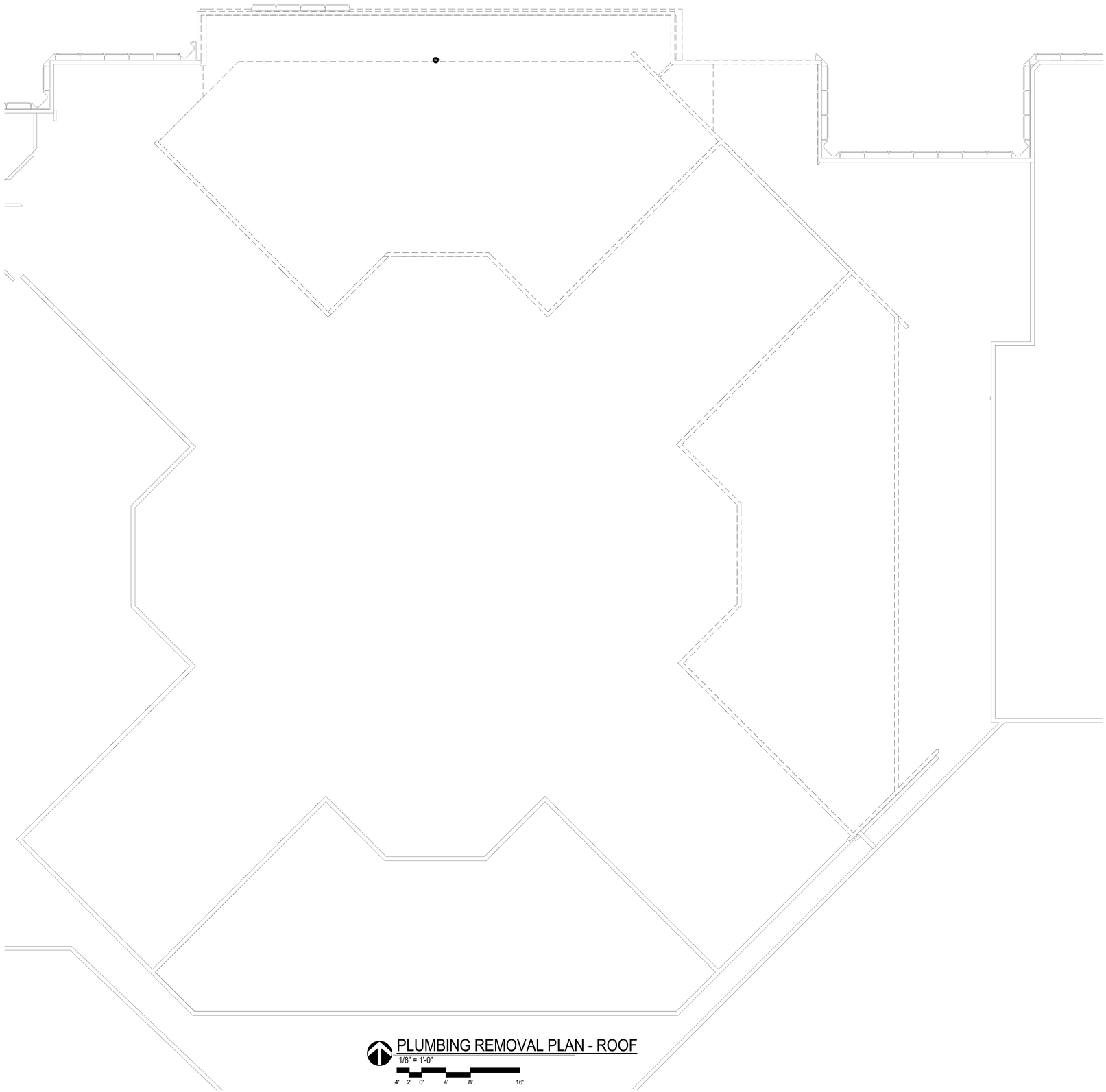
P
072

GENERAL NOTES

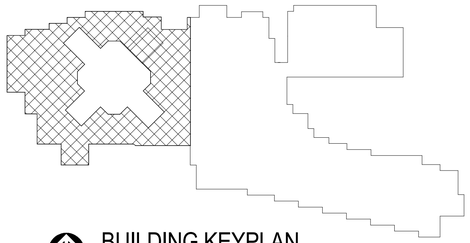
1. THIS PROJECT IS DIVIDED INTO TWO PHASES: "CORE AND SHELL" AND "TENANT INTERIORS". REFER TO SECTION 011100 RESPONSIBILITY MATRIX IN THE PROJECT MANUAL FOR A DETAILED BREAKDOWN OF WORK IN EACH PHASE.

WORK NOTES

WR4	STORM SYSTEM TO REMAIN IN USE DURING CONSTRUCTION.



PLUMBING REMOVAL PLAN - ROOF
1/8" = 1'-0"
4' 2' 0' 4' 8' 16'



BUILDING KEYPLAN
NOT TO SCALE

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PLUMBING REMOVAL PLAN - ROOF

P
073

GENERAL NOTES

1. THIS PROJECT IS DIVIDED INTO TWO PHASES: "CORE AND SHELL" AND "TENANT INTERIORS". REFER TO SECTION 011100 RESPONSIBILITY MATRIX IN THE PROJECT MANUAL FOR A DETAILED BREAKDOWN OF WORK IN EACH PHASE.
2. ROUTE NEW DOMESTIC COLD, HOT AND HOT RECIRCULATION PIPING, FROM CONNECTIONS TO EXISTING MAIN PIPING IN CRAWLSPACE LEVEL, CONNECTING TO EXISTING SYSTEMS TO REMAIN, AS WELL AS CONNECTIONS TO NEW SYSTEMS INSTALLED WITHIN THIS PROJECT. PIPING SHALL BE CONSTRUCTED SO THAT EXISTING SPACES SHALL NOT LOSE SERVICE TO THESE SYSTEMS.

WORK NOTES

W6 C/S PHASE: ROUTE 2 1/2"CW, 1 1/2"HW, 3/4"HWC UP TO LEVEL ABOVE. PROVIDE SHUTOFF BALL VALVES.

IE=5383.00'
6" 2-WAY GCO
8" SD UP
6" 2-WAY GCO
6" 2-WAY GCO
2" W UP
IE=5377.29'
(E)8"W
8" SD
2" W UP
4" W
(E)8"W
(E)8" SD
SP-1
2" SD UP
3" W UP
2" W UP
2" W UP
3" W
2" W UP
4" W UP TO 4"WCO
2" W UP
3" SD UP
(E)2" CW
W6
3" W
3" W UP
IE=5378.27'
8" SD
COORDINATE EXACT LOCTION FOR TIE-IN TO CIVIL PIPING SERVING AREA DRAINS
(E)8" SD
(E)8" W
(E)8" W
(E)8" W
(E)8" SD
(E)8" SD
(E)8" W
(E)8" W
6" SD
1" HWC
3" CW
2" HW
(E)2" HW
(E)3" CW
(E)8" W
(E)6" W
1" HWC
3" CW
2" HW
(E)1 1/2" HW
(E)2 1/2" CW
(E)1" HWC
1" HWC
2" HW
3" CW
1" HWC
2" HW
3" CW
1" HWC
2" HW
3" CW

PLUMBING PLAN - CRAWLSPACE & LOWER LEVEL

1/8" = 1'-0"

4' 2' 0' 4' 8' 16'

BUILDING KEYPLAN

NOT TO SCALE

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JEAN
REGISTERED
2018
PROFESSIONAL ENGINEER
32983
6 · 1 · 2018

Owner
Boulder County
Building Services Division
2020 13th Street
Boulder, Colorado 80302
303.441.3925

Architect / Landscape
Short Elliott Hendrickson, Inc.
2000 South Colorado Boulevard
Tower One, Suite 6000
Denver, Colorado 80222
720.540.6800

Civil / Structural
JVA, Inc.
1319 Spruce St.
Boulder, Colorado 80302
303.444.1951

MEP Engineer
BCER Engineering, Inc.
5420 Ward Rd.
Arvada, Colorado 80002
303.422.7400

Boulder County Building Services Division

JUSTICE CENTER DA INFILL

1777 6th St.
Boulder, CO 80302

SEH Project	135948
Project Manager	JDA
Drawn By	REG

Project Status	**Issue Date**
CONSTRUCTION DOCUMENTS	11/09/2017

Revision Issue

Rev. #	Description	Date
1	Addendum 1	2017-12-01
2	PERMIT COMMENTS	2018-06-01

PLUMBING PLAN - CRAWLSPACE & LOWER LEVEL

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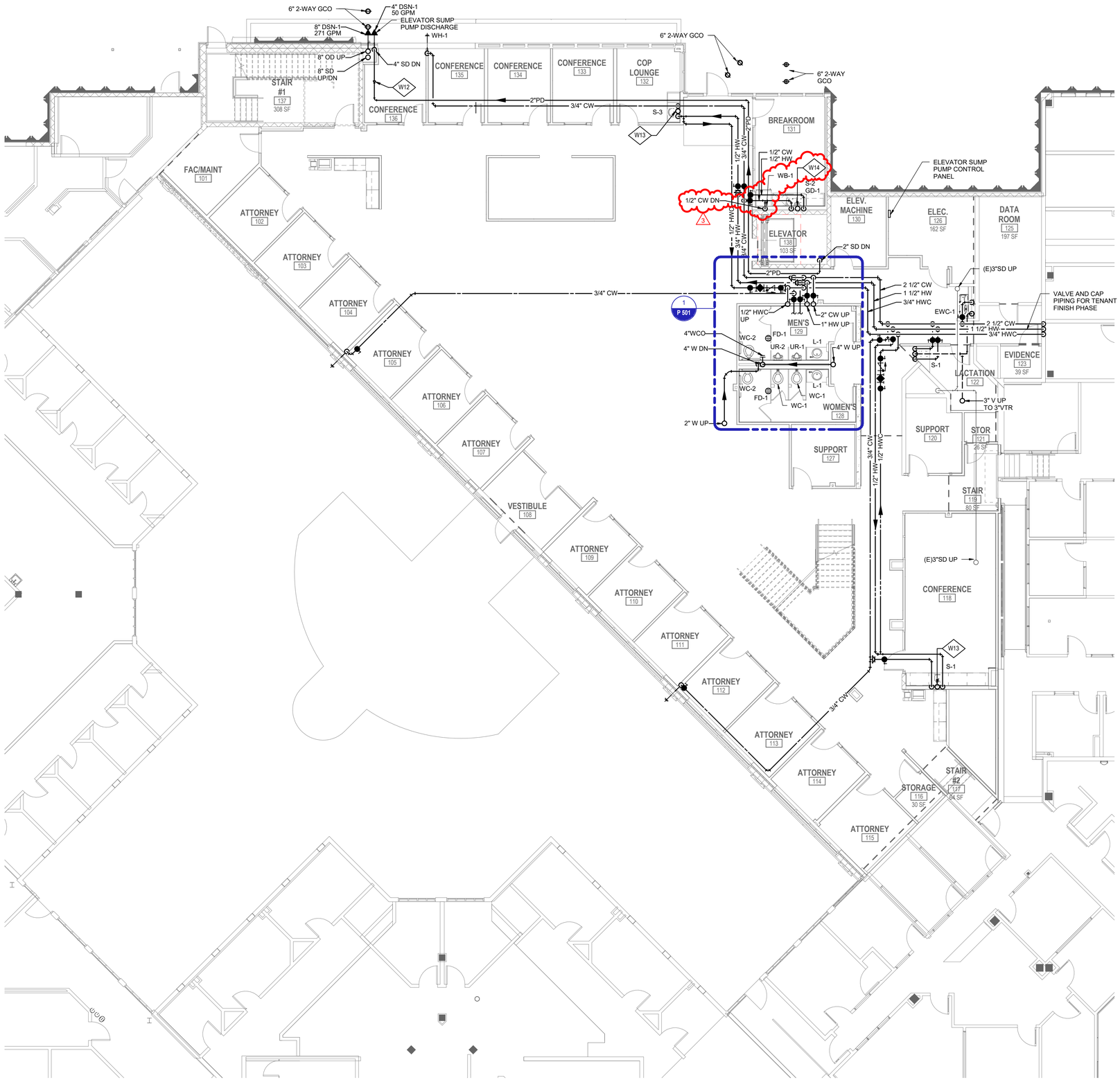
100



GENERAL NOTES

1. THIS PROJECT IS DIVIDED INTO TWO PHASES: "CORE AND SHELL" AND "TENANT INTERIORS". REFER TO SECTION 011100 RESPONSIBILITY MATRIX IN THE PROJECT MANUAL FOR A DETAILED BREAKDOWN OF WORK IN EACH PHASE.
2. ROUTE NEW DOMESTIC COLD, HOT AND HOT RECIRCULATION PIPING, FROM CONNECTIONS TO EXISTING MAIN PIPING IN CRAWLSPACE LEVEL, CONNECTING TO EXISTING SYSTEMS TO REMAIN, AS WELL AS CONNECTIONS TO NEW SYSTEMS INSTALLED WITHIN THIS PROJECT. PIPING SHALL BE CONSTRUCTED SO THAT EXISTING SPACES SHALL NOT LOSE SERVICE TO THESE SYSTEMS.

WORK NOTES

W12	C/S PHASE: TRANSITION 2"PD TO 4"W GRAVITY DRAINAGE AT THIS POINT.
W13	TRANSITION 2"V TO 3"VTR. COORDINATE ROOF PENETRATION WITH ANY ROOFTOP UNITS.- 10'-0" MINIMUM FROM INTAKE.
W14	ROUTE 1/2"CW/HW TO SINK AND OFFSET 1/2"HW TO DISHWASHER WITH ISOLATION BALL VALVE. REFER TO DETAIL FOR ADDITIONAL INFORMATION.

PLUMBING PLAN - LEVEL 1

1/8" = 1'-0"

4' 2' 0' 4' 8' 16'

BUILDING KEYPLAN

NOT TO SCALE

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COLORADO LICENSED PROFESSIONAL ENGINEER 32983 JEAN DAVIS 2018

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1	Addendum 1	2017-12-01
2	Addendum 2	2018-01-16
3	PERMIT COMMENTS	2018-06-01

PLUMBING PLAN - LEVEL 1

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201

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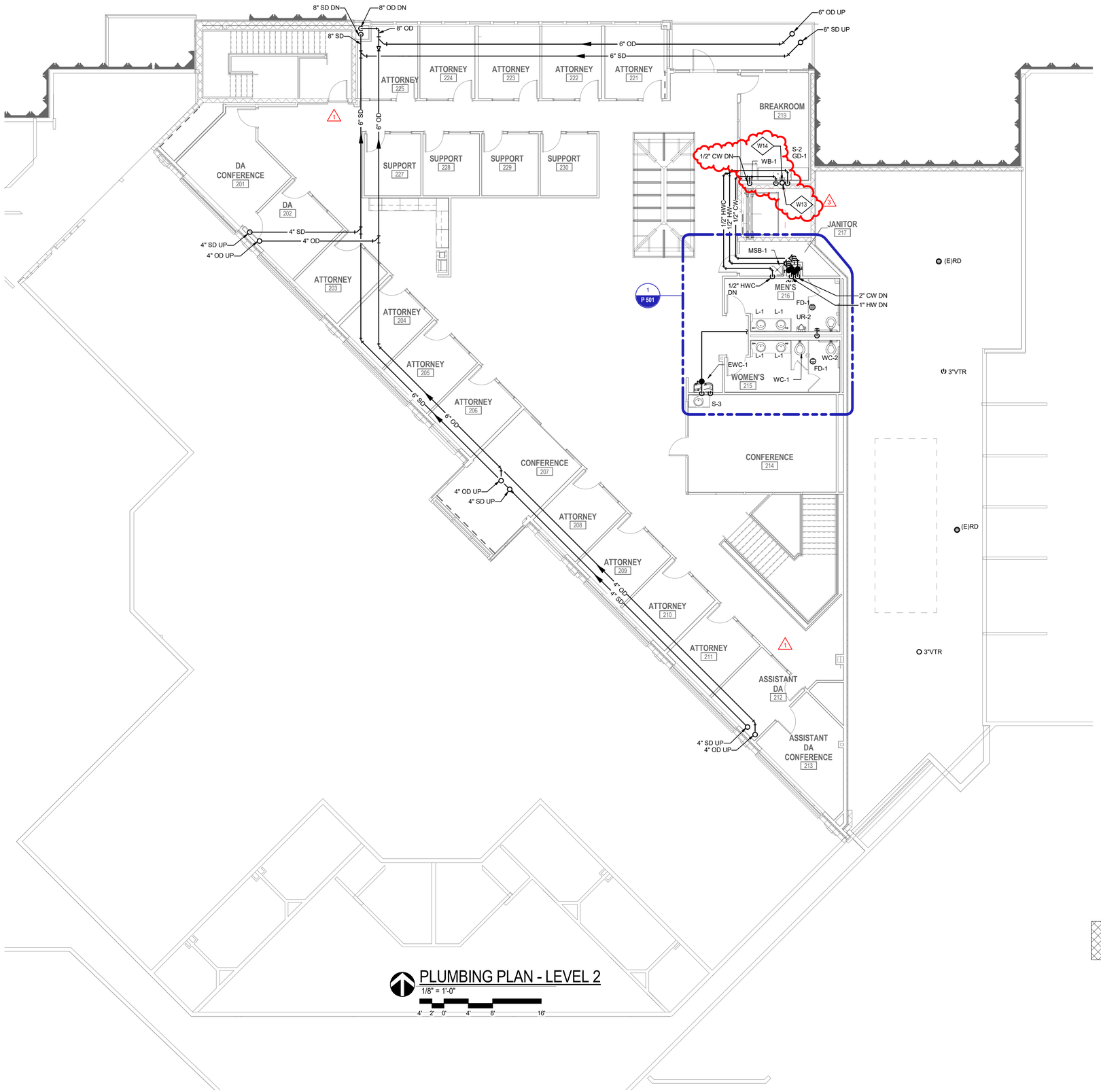
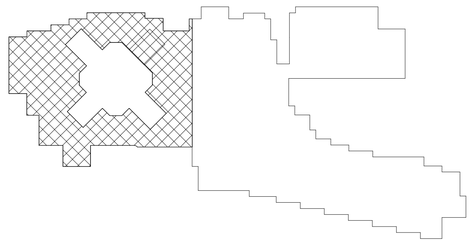
WORK NOTES

W13	TRANSITION 2"V TO 3"VTR. COORDINATE ROOF PENETRATION WITH ANY ROOFTOP UNITS.- 10'-0" MINIMUM FROM INTAKE.
W14	ROUTE 1/2"CW/HW TO SINK AND OFFSET 1/2"HW TO DISHWASHER WITH ISOLATION BALL VALVE. REFER TO DETAIL FOR ADDITIONAL INFORMATION.



PLUMBING PLAN - LEVEL 2
1/8" = 1'-0"
4' 2' 0' 4' 8' 16'



BUILDING KEYPLAN
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6.1.2018

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1	Addendum 1	2017-12-01
2	Addendum 2	2018-01-16
3	PERMIT COMMENTS	2018-06-01

PLUMBING PLAN - LEVEL 2

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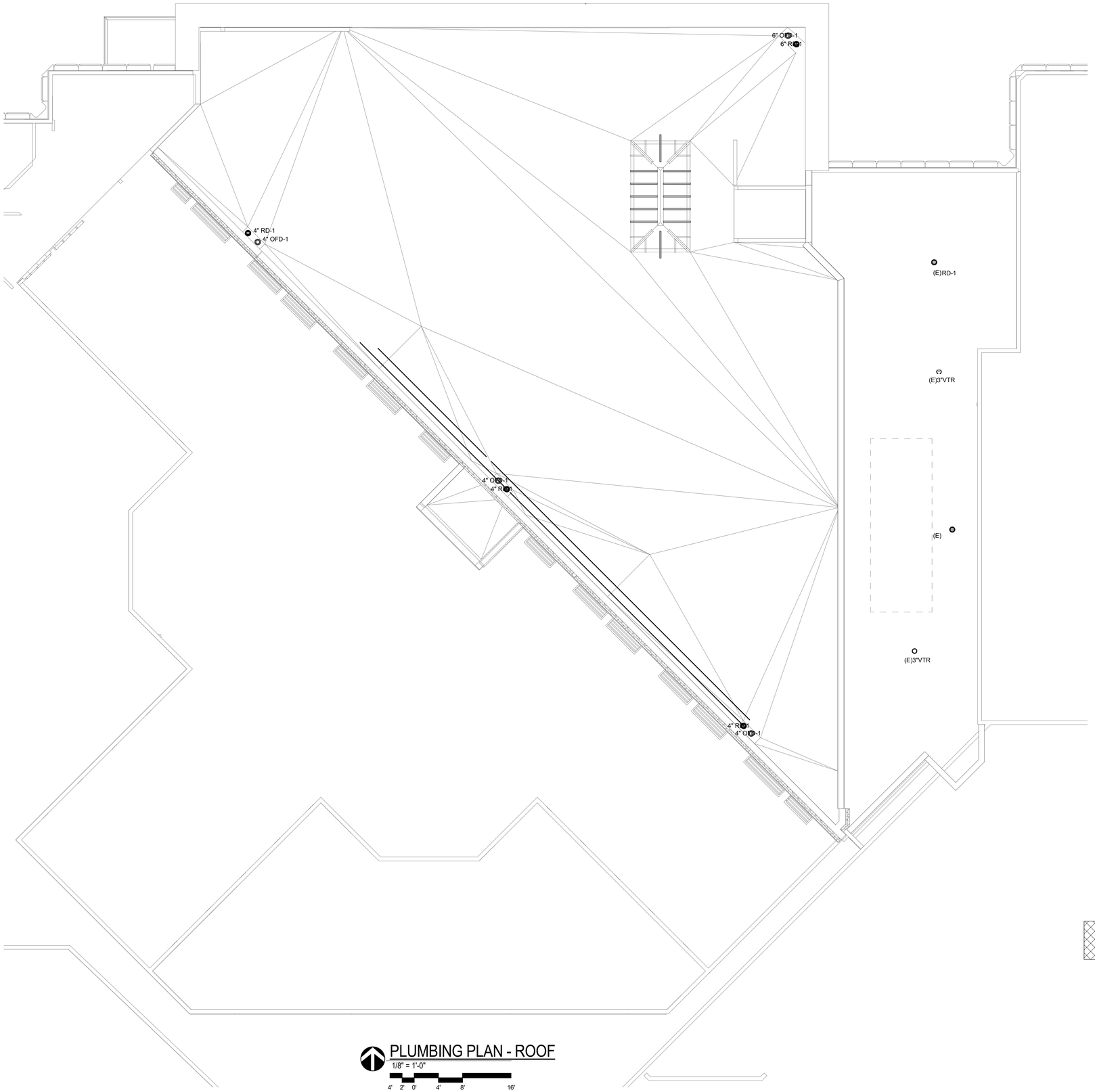
202



PLUMBING PLAN - ROOF

1/8" = 1'-0"

4' 2' 0' 4' 8' 16'

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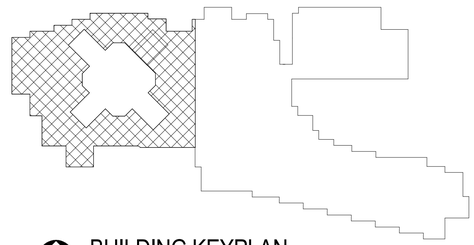
WORK NOTES



BUILDING KEYPLAN

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Revision Issue

Rev. #	Description	Date

PLUMBING PLAN - ROOF

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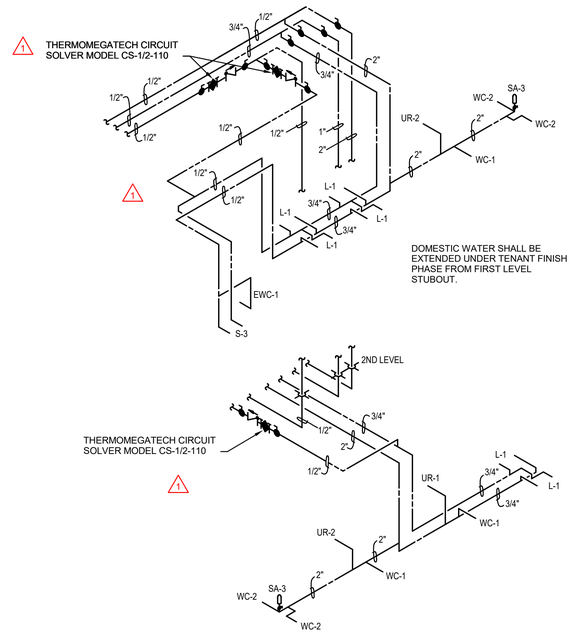
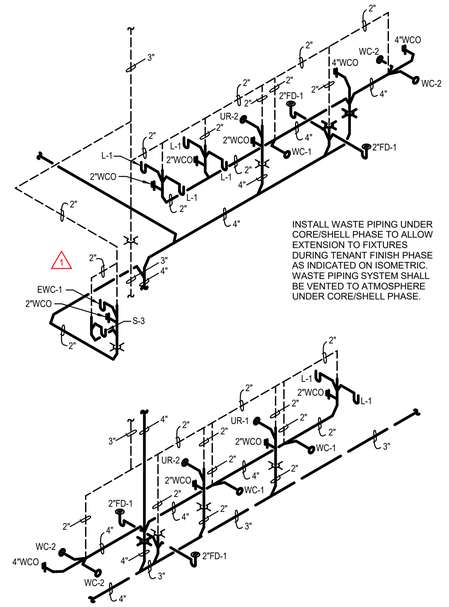
203





1 TOILET ROOM ISOMETRICS
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1	Addendum 1	2017-12-01

PLUMBING ISOMETRICS

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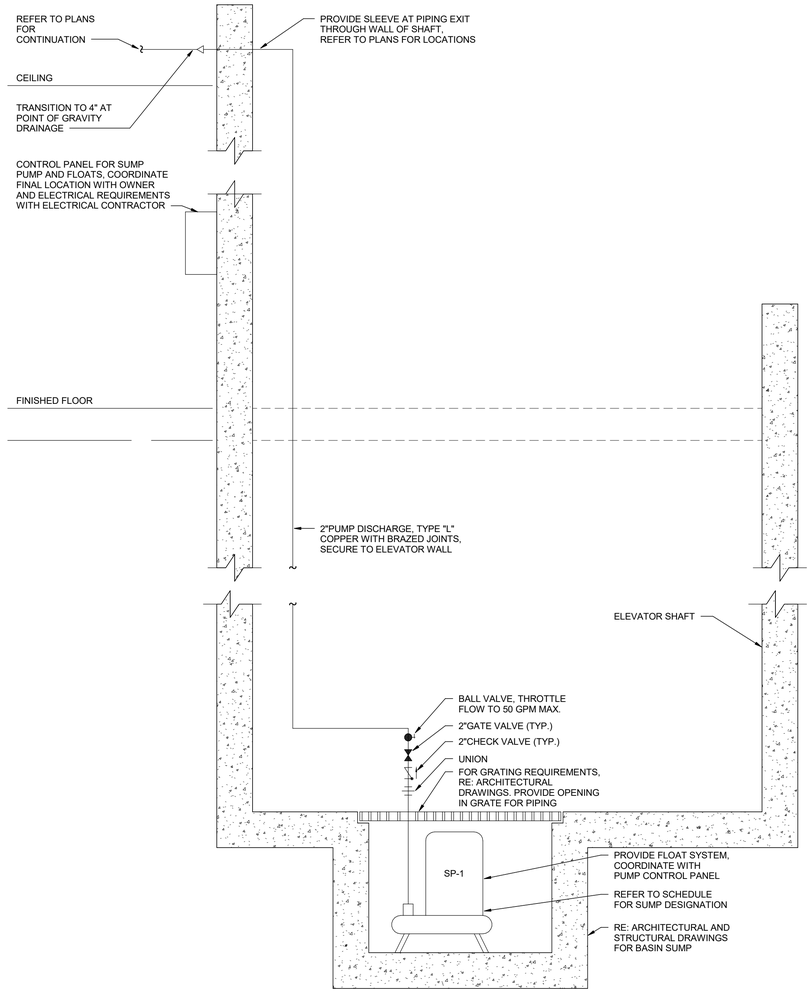
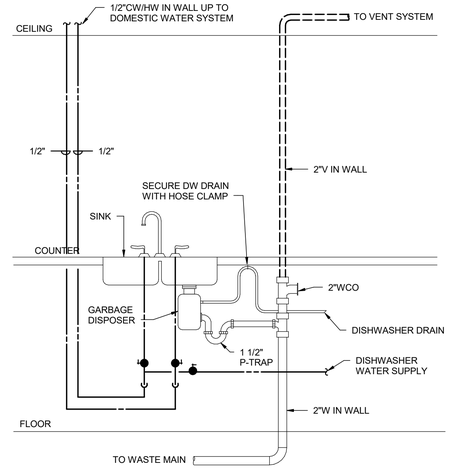
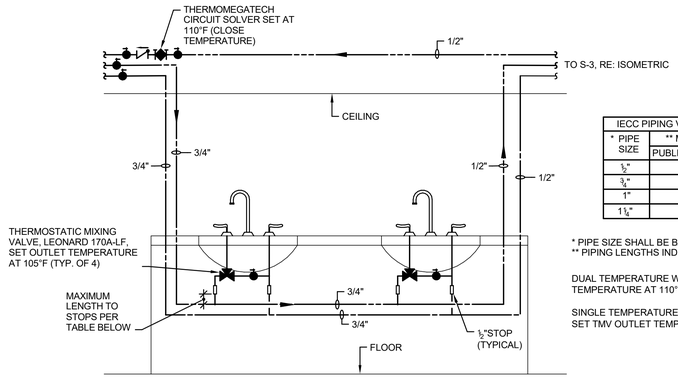
501



4 ELEVATOR EJECTOR PUMP PIPING DETAIL
NOT TO SCALE



1 DISHWASHER WATER /DRAIN CONNECTION DETAIL
NOT TO SCALE



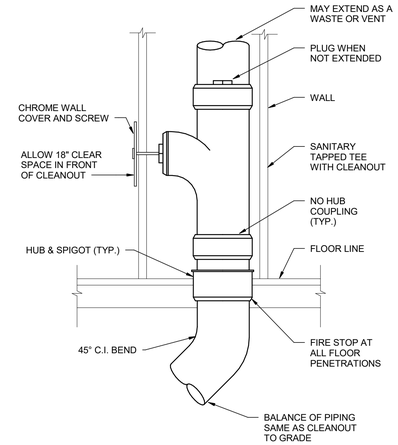
IECC PIPING VOLUME & MAXIMUM LENGTHS		
* PIPE SIZE	** MAXIMUM PIPING LENGTH (FT)	
	PUBLIC LAVATORY	OTHER FIXTURES
½"	2	43
¾"	0.5	21
1"	0.5	13
1¼"	0.5	8

* PIPE SIZE SHALL BE BASED ON THE LARGEST PIPE SIZE FROM MAIN
** PIPING LENGTHS INDICATED ARE FROM BRANCH TO STOP

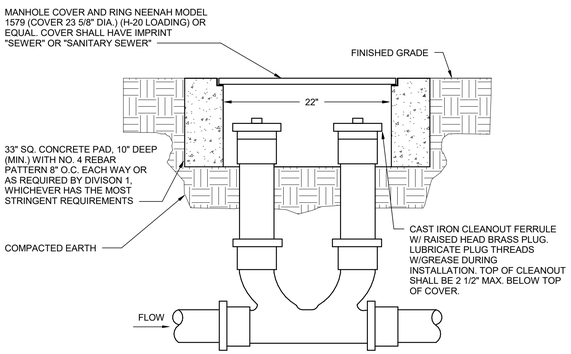
DUAL TEMPERATURE WATER TO FAUCET, SET TMV OUTLET TEMPERATURE AT 110°F.

SINGLE TEMPERATURE WATER TO SENSOR OR METERING FAUCET, SET TMV OUTLET TEMPERATURE AT 102°F.

5 221119.02 PUBLIC LAVATORY PIPING DIAGRAM
NOT TO SCALE



2 WALL CLEANOUT (WCO) DETAIL
NOT TO SCALE



3 TWO-WAY GRADE CLEANOUT (GCO) DETAIL
NOT TO SCALE

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COLORADO LICENSED PROFESSIONAL ENGINEER
Edward A. Dean
32983
6 · 1 · 2018

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PLUMBING DETAILS

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601

THIS CONTRACT ("Contract") is entered into between the County of Boulder, State of Colorado, acting by and through its Board of County Commissioners ("County") and (name of company) ("Contractor"), (collectively, the "Parties").

In consideration of the rights and obligations specified below, the County and the Contractor agree as follows:

1. Incorporation into Contract: The following documents (the "Contract Documents) are each expressly incorporated into this Contract by reference:
   a. *The Invitation for Bid or Request for Proposal and Specifications of Boulder County Bid No.*_____ together with any alterations and/or modifications to these Specifications (the "Bid Documents"); **[if applicable]**
   b. Contractor's proposal in response to the Bid Document (the "Proposal"); **[if applicable]**
   c. The scope of services, attached hereto as Exhibit A (the "Scope of Services"); **[if applicable]** and
   d. The fee schedule, attached hereto as Exhibit B (the "Fee Schedule"). **[if applicable]**

2. Work to be Performed: The Contractor will, in a good and workmanlike manner and at its own cost and expense, furnish all labor and equipment and do all work necessary and incidental to performing (specify type of work) as specified in the Contract Documents and this Contract (the "Work"). The Contractor shall perform the Work in strict accordance with the Contract Documents and this Contract.

3. Term of Contract: This Contract shall begin and become effective on the date of execution by the parties, which date is the date specified on the signature page of this Contract. Under this Contract, the Contractor shall begin Work on (date) and shall continue through (date).

4. Payment for Work Performed: In consideration of the Work to be performed by the Contractor, and subject to paragraph 14, the County shall pay to the Contractor, in accordance with the Contract Documents, $ (contract price) .
   a. Invoicing: The Contractor shall submit an invoice to the [INSERT DEPARTMENT] by the [INSERT DAY] of the month following the completion of work.
   b. **All invoices submitted require the following components**: Contractor's name and address (which must match the submitted W-9 or W-9 with remit address), payment remittance address, payer, name and address, date of invoice, invoice number, brief description of services, dates of services, and total amount due.
   c. Send completed invoices to: [INSERT DEPARTMENT AND ADDRESS]
   d. Failure to submit invoices in a timely manner and in accordance with the terms of this Contract may cause a delay in payment.
   e. The County reserves the right to recoup any damages incurred as a result of Contractors failure to submit invoices pursuant to the terms of this paragraph.

5. Extension and/or Renewal of Contract Term:

   a. The County, in its sole discretion, may elect to extend the term of this Contract. In

the event the County elects to exercise this right, it shall send notice to Contractor, pursuant to paragraph 15, of its intent to extend the term of the Contract. The notice shall set forth the length of the extension.

b. Upon mutual agreement by the parties, this Contract may be renewed for four additional one-year periods through __date__ during which time this Contract shall be in full force and effect, subject to the termination provisions of paragraph 14. If this option to renew is exercised, the parties shall execute a written agreement no later than thirty (30) days before the expiration of this Contract or any subsequent renewals.

c. All of the provisions of this Contract shall remain in full force and effect during any extension or renewed term except that the scope of services and compensation to be paid to Contractor during any extension or renewed term shall be mutually agreed upon prior to the commencement of any extension or renewed term. The agreed upon scope of services and compensation shall be reduced to writing, signed by both parties, and attached to this Contract.

d. **TEN CALENDAR DAYS BEFORE THE COMMENCEMENT OF ANY EXTENDED TERM THE CONTRACTOR SHALL SUBMIT TO THE COUNTY PROOF OF INSURANCE AS REQUIRED IN PARAGRAPH 9.**

e. Should the Parties fail to agree upon the scope of services or compensation to be paid to Contractor for any extension or renewed term, or should Contractor fail to submit the required documents within the time period specified in paragraph 5(d), then this Contract shall terminate at the end of the then current term and no extension or renewal of the term of the Contract shall occur.

6. Quality of Performance: The Contractor shall perform the Contract in a manner satisfactory and acceptable to the County. The County shall be the sole judge of the quality of performance.

7. Schedule of Work: The Contractor shall perform the Work during the hours designated by the County so as to avoid inconvenience to the County and its personnel and interference with the County's operations.

8. Indemnity: The Contractor shall be liable and responsible for any and all damages to persons or property caused by or arising out of the actions, obligations, or omissions of the Contractor, its employees, agents, representatives or other persons acting under the Contractor's direction or control in performing or failing to perform the Work under this Contract. The Contractor will indemnify and hold harmless the County, its elected and appointed officials, and its employees, agents and representatives (the "indemnified parties"), from any and all liability, claims, demands, actions, damages, losses, judgments, costs or expenses, including but not limited to attorneys' fees, which may be made or brought or which may result against any of the indemnified parties as a result or on account of the actions or omissions of the Contractor, its employees, agents or representatives, or other persons acting under the Contractor's direction or control.

9. Insurance Requirements: The Contractor shall procure and maintain at its own expense, and without cost to the County, the following kinds and minimum amounts of insurance for purposes of insuring the liability risks which the Contractor has assumed until this Contract has expired or is terminated:

a. Commercial General Liability.

Construction Contracts only – include the following paragraph:

Coverage should be provided on an Occurrence form, ISO CG0001 or equivalent. The policy shall be endorsed to include Additional Insured endorsements CG 2010 (or equivalent), Designated Construction Projects General Aggregate Endorsement CG2503 (or equivalent) and Additional Insured (for products/completed operations) CG 2037 (or equivalent). Minimum limits required of $1,000,000 Each Occurrence, $2,000,000 General Aggregate and $2,000,000 Products Completed Operations Aggregate". The County requires Products/Completed Operations coverage to be provided 2 years after completion of construction. An endorsement must be included with the certificate.

b. **Automobile Liability.**

Bodily Injury and Property Damage for any owned, hired, and non-owned vehicles used in the performance of the Contract. Minimum limits $1,000,000 Each Accident.

This coverage may not be required if Contractor is not using a vehicle as part of its performance under the contract. Contact Risk Management with any questions.

c. **Workers' Compensation and Employer's Liability**.

Workers' Compensation must be maintained with the statutory limits. Employer's Liability is required for minimum limits of $100,000 Each Accident/$500,000 Disease-Policy Limit/$100,000 Disease-Each Employee.

This coverage may not be required if contractor is not mandated under State law to maintain this coverage. A waiver is available on the contracts routing website.

d. **Umbrella / Excess Insurance**

Umbrella/Excess Liability insurance in the amount $X,000,000.00, following form.

This insurance is a broad, high-limit policy, which acts in excess of the underlying primary insurance policy. This coverage is designed to provide additional liability limits beyond the primary insurance limits, and is triggered upon the underlying limits becoming exhausted. Umbrella / Excess insurance is most commonly required when an exposure to the County could potentially create liabilities in excess of the basic insurance limits. The most common limits for these policies range from $2,000,000 to $5,000,000.

Please consult with Risk Management if you feel this coverage should be required.

IN ADDITION TO THE ABOVE, ONE OR MORE OF THE FOLLOWING FOUR (4) INSURANCE COVERAGES MAY BE REQUIRED. CONTACT RISK MANAGEMENT IF YOU HAVE QUESTIONS ABOUT WHICH INSURANCE COVERAGE TO INCLUDE. DELETE THIS INSTRUCTION (AND ANY INAPPLICABLE INSURANCE PARAGRAPHS) WHEN FINALIZING THE CONTRACT:

e. **Professional Liability (Errors and Omissions).**

All contractors required to be professionally certified by the State of Colorado (i.e., architects, engineers, doctors, nurses, etc.) and/or any consultants whose errors in judgment, planning, design, etc. could result in economic loss to the County must provide proof of professional liability coverage.

Professional liability coverage with minimum limits of $1,000,000 Per Loss and $1,000,000 Aggregate. Professional Liability provisions indemnifying for loss and expense resulting from errors, omission, mistakes or malpractice is acceptable and may be written on a claims made basis. The contractor warrants that any retroactive date under the policy shall precede the effective date of this Contract; and that either continuous coverage will be maintained or an extended discovery period will be exercised for a period of two (2) years beginning at the time work under this Contract is completed.

f. **Pollution Liability.**

This coverage is required whenever work under the contract involves pollution risk to the environment or losses caused by pollution conditions (including asbestos) that may arise from the operations of the Contractor described in the Contractor's scope of services.

Coverage shall cover the Contractor's completed operations. The coverage must also include sudden and gradual pollution conditions including clean-up costs when mandated by governmental authority, when required by law or as a result of a third party claim. Minimum limits required are $1,000,000 Per Loss and $1,000,000 Aggregate. If the coverage is written on a claims-made basis, the Contractor warrants that any retroactive date applicable to coverage under the policy precedes the effective date of this Contract; and that continuous coverage will be maintained or an extended discovery period will be exercised for a period of three (3) years beginning from the time that work under this contract is completed.

If the scope does not pertain to clients directly, contact Risk Management for appropriate language.

THE STATED INSURANCE LIMITS FOR ALL COVERAGES ARE MINIMUM AMOUNTS; DEPENDING ON THE CONTRACT, HIGHER LIMITS MAY BE REQUIRED OR ADVISABLE. CONTACT RISK MANAGEMENT IF YOU HAVE ANY QUESTIONS ABOUT MINIMUM LIMITS. DELETE THIS PARAGRAPH WHEN

FINALIZING THE CONTRACT.

The Contractor shall provide a Certificate of Insurance to Boulder County demonstrating that the insurance requirements have been met prior to the commencement of Work under this Contract. Boulder County shall be named as an additional insured for General Liability and Pollution Liability, as designated in the contract. Additional insured shall be endorsed to the policy.

THE ADDITIONAL INSURED WORDING SHOULD BE AS FOLLOWS: *County of Boulder, State of Colorado, a body corporate and politic, is named as Additional Insured.*

Contractor shall forward certificates of insurance directly to **(_____) Agency / Department Representative's Name & Address)**.

Notice of Cancellation: Each insurance policy required by the insurance provisions of this Contract shall provide the required coverage and shall not be suspended, voided or canceled except after thirty (30) days prior written notice has been given to the County, except when cancellation is for non-payment of premium, then ten (10) days prior notice may be given. If any insurance company refuses to provide the required notice, the Contractor or its insurance broker shall notify the County of any cancellation, suspension, and/or nonrenewal of any insurance within seven (7) days of receipt of insurers' notification to that effect.

Please forward certificates to the county representative named above.

10. Nondiscrimination: The Contractor agrees to comply with the letter and spirit of the Colorado Anti-Discrimination Act, C.R.S. § 24-34-401, et seq., as amended, and all applicable local, state and federal laws respecting discrimination and unfair employment practices. Boulder County prohibits unlawful discrimination on the basis of race, color, religion, gender, gender identity, national origin, age 40 and over, disability, socio-economic status, sexual orientation, genetic information, or any other status protected by applicable federal, state or local law and the Boulder County Policy manual (of which is available upon request).

11. Nondiscrimination Provisions Binding on Subcontractors: In all solicitations by the Contractor for any Work related to this Contract to be performed under a subcontract, either by competitive bidding or negotiation, the Contractor shall notify each potential subcontractor of the Contractor's obligations under this Contract, and of all pertinent regulations relative to nondiscrimination and unfair employment practices.

12. Information and Reports: The Contractor will provide to authorized governmental representatives, including those of the County, State and Federal Government, all information and reports which they may require for any purpose authorized by law. The Contractor will permit such authorized governmental representatives access to the Contractor's facilities, books, records, accounts, and any other relevant sources of information. Where any information required by any such authorized government representative is in the exclusive possession of a person other than the Contractor, then such Contractor shall so certify to the County, and shall explain what efforts it has made to obtain the information.

13. Independent Contractor: The Parties recognize and agree that the Contractor is an

independent contractor for all purposes, both legal and practical, in performing services under this Contract, and that the Contractor and its agents and employees are not agents or employees of Boulder County for any purpose. As an independent contractor, the Contractor shall be responsible for employing and directing such personnel and agents as it requires to perform the services purchased under this Contract, shall exercise complete authority over its personnel and agents, and shall be fully responsible for their actions.

Contractor acknowledges that it is not entitled to unemployment insurance benefits or workers' compensation benefits from Boulder County, its elected officials, agents, or any program administered or funded by Boulder County. Contractor shall be entitled to unemployment insurance or workers' compensation insurance only if unemployment compensation coverage or workers' compensation coverage is provided by Contractor, or some other entity that is not a party to this Contract. Contractor is obligated to pay federal and state income tax on any monies earned pursuant to this Contract.

14. Termination and Related Remedies:

a. The other provisions of this Contract notwithstanding, financial obligations of Boulder County payable after the current fiscal year are contingent upon funds for that purpose being appropriated, budgeted and otherwise made available. **Boulder County is prohibited by law from making financial commitments beyond the term of its current fiscal year.** The County has contracted for goods and/or services under this Contract and has reason to believe that sufficient funds will be available for the full term of the Contract. Where, however, for reasons beyond the control of the Board of County Commissioners as the funding entity, funds are not allocated for any fiscal period beyond the one in which this Contract is entered into, the County shall have the right to terminate this Contract by providing seven (7) days written notice to the Contractor pursuant to paragraph 15, and will be released from any and all obligations hereunder. If the County terminates the Contract for this reason, the County and the Contractor shall be released from all obligations to perform Work and make payments hereunder, except that the County shall be required to make payment for Work which has been performed by the Contractor prior to the effective date of termination under this provision; and, conversely, the Contractor shall be required to complete any Work for which the County has made payment prior to providing written notice to the Contractor of the termination.

b. The preceding provisions notwithstanding, the County may terminate this Contract, either in whole or in part, for any reason, whenever the County determines that such termination is in the County's best interests. Such termination shall be effective after the County provides seven (7) days written notice to the Contractor pursuant to paragraph 15.

c. In the event the County exercises either of the termination rights specified in paragraphs 14(a) or 14(b), this Contract shall cease to be of any further force and effect, with the exception of all Contract remedies which are specified herein and may otherwise be available to the parties under the law, and with the exception of any rights or liabilities of the parties which may survive by virtue of this Contract.

15. Notices: For purposes of the notices required to be provided under paragraphs 5, 9, and 14, all such notices shall be in writing, and shall be either sent by Certified U.S. Mail - Return Receipt Requested, Electronic Mail, or hand-delivered to the following representatives of the parties at the following addresses:

For the County: (enter DH/EO's name, Department, Mailing and Email Address)
For the Contractor: (enter Contractor's name, Mailing and Email Address)

In the event a notice is mailed pursuant to the provisions of this paragraph, the time periods specified in paragraph 14 shall commence to run on the day after the postmarked date of mailing.

16. Statutory Requirements: This Contract is subject to all statutory requirements that are or may become applicable to counties or political subdivisions of the State of Colorado generally. Without limiting the scope of this provision, the Contract is specifically subject to the following statutory requirement:

Contract payments may be withheld pursuant to C.R.S. § 38-26-107 if the County receives a verified statement that the Contractor has not paid amounts due to any person who has supplied labor or materials for the project.

17. Prohibitions on Public Contract for Services: **(REMOVE THIS SECTION IF NOT A SERVICE CONTRACT)**

Pursuant to Colorado Revised Statutes (C.R.S.), § 8-17.5-101, et seq., as amended, the Contractor shall meet the following requirements prior to signing this Contract (public contract for service) and for the duration thereof:

a. The Contractor shall not knowingly employ or contract with an illegal alien to perform work under this public contract for services.

b. The Contractor shall not enter into a contract with a subcontractor that fails to certify to the Contractor that the subcontractor shall not knowingly employ or contract with an illegal alien to perform work under this public contract for services.

c. At the time of signing this public contract for services, the Contractor has confirmed the employment eligibility of all employees who are newly hired for employment to perform work under this public contract for services through participation in either the E-Verify Program or the Department Program.

d. The Contractor shall not use either the E-Verify Program or the Department Program procedures to undertake pre-employment screening of job applicants while this public contract for services is being performed.

e. If Contractor obtains actual knowledge that a subcontractor performing work under this public contract for services knowingly employs or contracts with an illegal

alien, the Contractor shall: notify the subcontractor and the County within three days that the Contractor has actual knowledge that the subcontractor is employing or contracting with an illegal alien; and, terminate the subcontract with the subcontractor if within three days of receiving the notice required pursuant to the previous sentence, the subcontractor does not stop employing or contracting with the illegal alien; except that the contractor shall not terminate the contract with the subcontractor if during such three days the subcontractor provides information to establish that the subcontractor has not knowingly employed or contracted with an illegal alien.

f. Contractor shall comply with any reasonable requests by the Department of Labor and Employment (the Department) made in the course of an investigation that the Department is undertaking pursuant to the authority established in C.R.S. § 8-17.5-102(5).

g. If Contractor violates any provisions of this Section of this Contract the County may terminate this Contract for breach of contract. If the Contract is so terminated, the Contractor shall be liable for actual and consequential damages to the County.

18. Amendments: This Contract may be altered, amended or repealed only on the mutual agreement of the County and the Contractor by a duly executed written instrument.

19. Assignment: This Contract shall not be assigned or subcontracted by the Contractor without the prior written consent of the County.

20. Complete Agreement/Binding Effect: This Contract represents the complete agreement between the Parties hereto and shall be fully binding upon the successors, heirs, and assigns of the Parties, if any, during the term hereof.

21. Governing Law: The laws of the State of Colorado shall govern the interpretation and enforcement of this Contract. Any litigation that may arise between the parties involving the interpretation or enforcement of the terms of this Contract shall be initiated and pursued by the parties in the Courts of the 20th Judicial District of the State of Colorado and the applicable Colorado Appellate Courts.

22. Breach: Any waiver of a breach of this Contract shall not be held to be a waiver of any other or subsequent breach of this Contract. All remedies afforded in this Contract shall be taken and construed as cumulative, that is, in addition to every other remedy provided herein or by law.

23. Termination of Prior Agreements: This Contract cancels and terminates, as of its effective date, all prior agreements between the parties relating to the services covered by this Contract, whether written or oral or partly written and partly oral.

24. Invalidity Provision: Should any of the provisions of this Contract be held to be invalid or unenforceable, then the balance of the agreement shall be held to be in full force and effect as though the invalid portion was not included; provided, however, that should the invalidity

or unenforceability go to the essence of the agreement or be of substantial nature, then the Party or Parties who would receive the benefit of the provision, were it not invalid or unenforceable, shall have the option to terminate this Contract, forthwith.

25. Third Party Beneficiary: The enforcement of the terms and conditions of this Contract and all rights of action relating to such enforcement shall be strictly reserved to the County and the Contractor, and nothing contained in this Contract shall give or allow any claim or right of action whatsoever by any other or third person. It is the express intent of the parties to this Contract that any person receiving services or benefits under this Contract shall be deemed an incidental beneficiary only.

26. Conflict of Provisions: In the event of any conflict between the terms of this Contract and the terms of any attachments or addenda, the terms of this Contract shall control.

27. Governmental Immunity: Nothing in this Contract shall be construed in any way to be a waiver of the County's immunity protection under the Colorado Governmental Immunity Act, C.R.S. § 24-10-101, et seq., as amended.

28. Representations and Warranties: Contractor represents and warrants the following to The County, as a material inducement to the County to execute this Contract, which representations and warranties shall survive the execution and delivery of this Contract, any termination of this Contract, and the final completion of the work.

a. Execution of this Contract and performance thereof is within the Contractor's duly authorized powers;
b. Any individual executing this Contract is authorized to do so by the Contractor;
c. The Contractor is authorized to do business in the State of Colorado and is properly licensed by all necessary governmental and public and quasi-public authorities having jurisdiction over the Work and the project; and
d. The Contractor and its subcontractors, if any, are financially solvent, able to pay all debts as they mature, and possessed of sufficient working capital to complete the work and perform all obligations under the Contract.

29. Execution by Counterparts; Electronic Signatures: This Contract may be executed in two or more counterparts, each of which shall be deemed an original, but all of which shall constitute one and the same instrument. The Parties approve the use of electronic signatures for execution of this Contract Only the following two forms of electronic signatures shall be permitted to bind the Parties to this Contract: (1) Electronic or facsimile delivery of a fully executed copy of a signature page; (2) The image of the signature of an authorized signer inserted onto PDF format documents. All use of electronic signatures shall be governed by the Uniform Electronic Transactions Act, C.R.S. §§ 24-71.3-101 to 121.

[Signature Page to Follow]

IN WITNESS WHEREOF, the Parties have executed and entered into this Contract as of the latter day and year indicated below.

Executed by Boulder County on _____.
(date)

COUNTY OF BOULDER
STATE OF COLORADO

ATTEST: _____

By: _____
Administrative Assistant
Clerk to the Board of Commissioners

(seal)

By: _____
Deb Gardner, Chair,
Board of County Commissioners

Executed by Contractor on _____.
(date)

CONTRACTOR:

Signature: _____

Title: _____

Print Name: _____

CONTRACTOR'S CERTIFICATION OF COMPLIANCE

Pursuant to Colorado Revised Statutes, § 8-17.5-101,et seq., as amended, as a prerequisite to entering into a contract for services with Boulder County, Colorado, the undersigned Contractor hereby certifies that at the time of this certification, Contractor does not knowingly employ or contract with an illegal alien who will perform work under the attached contract for services and that the Contractor will participate in the E-Verify Program or Department program, as those terms are defined in C.R.S. § 8-17.5-101, et seq., in order to confirm the employment eligibility of all employees who are newly hired for employment to perform work under the attached contract for services.

CONTRACTOR:

_____ _____
Company Name Date

_____
Name (Print or Type)

_____
Signature

_____
Title

Note: Registration for the E-Verify Program can be completed at: https://e-verify.uscis.gov/enroll/.

GENERAL CONDITIONS

A. COUNTY'S (OWNER'S) RESPONSIBILITIES

1. Information on services under the control of the County (hereinafter referred to also as the Owner) shall be furnished by the County with reasonable promptness to avoid delay in the orderly progress of the Work.

2. Based on the observations of the County's Representative and an evaluation of the Contractor's Applications for Payment, the County will determine the amounts owing to the Contractor and will issue Certificates for Payment in accordance with the General Conditions on Progress Payments and Final Payments.

3. The Owner's Representative will be the interpreter of the requirements of the Contract Documents. He will make decisions on all claims, disputes or other matters in question between the Contractor and the Owner but he will not be liable for the results of any interpretation or decision rendered in good faith. Decisions of the Architect will be final, if consistent with the intent of the Contract Documents.

4. The Owner's Representative will have authority to reject Work which does not conform to the Contract Documents.

5. The Owner's Representative will have the authority to contact any regulatory agency concerning any alleged regulatory violation and to secure regulatory ruling or suspend work until such ruling is obtained. Such delays if confirmed to be an infraction or variance may give rise to charges against the Contractor by the County for delay of timely completion of contract work.

6. The Owner's Representative will review and approve or take other appropriate action upon the Contractor's submittals, such as Shop Drawings, Product Data, and Samples, but only for conformance with the design concept of the Work and with the information given in the Contract Documents.

B. CONTRACTOR'S RESPONSIBILITIES

1. The Contractor shall supervise and direct the Work, using his best skill and attention and he shall be solely responsible for all construction means, methods, techniques, sequences and procedures and for coordinating all portions of the Work under the Contract.

2. Unless otherwise specifically provided in the Contract Documents, the Contractor shall provide and pay for all labor, materials, equipment, tools, construction equipment and machinery, transportation, and other facilities and services necessary for the proper execution and completion of the Work whether or not incorporated or to be incorporated in the Work.

3. The Contractor shall at all times enforce strict discipline and good order among his employees and shall not employ on the Work any unfit person or anyone not skilled in the task assigned to him.

4. The Contractor warrants to the County that all materials and equipment incorporated in the Work will be new unless otherwise specified, and that all Work will be of

good quality, free from faults and defects and in conformance with the Contract Documents. All Work not conforming to these requirements may be considered defective.

5. Unless otherwise provided in the Contract Documents, the Contractor shall pay all sales, consumer, use and other similar taxes which are legally enacted at the time bids are received and the Contractor will obtain any permits and pay governmental fees, licenses and inspections necessary for the proper execution and completion of the Work.

6. The Contractor shall give all notices and comply with all laws, ordinances, rules, regulations, and lawful orders of any public authority bearing on the performance of the Work, and shall promptly notify the County if the Drawings and Specifications are at variance therewith. If the Contractor performs any work contrary to such laws, ordinances, rules or regulations, he shall bear all costs arising therefore.

7. The contractor shall be solely responsible for the acts and omissions of his employees, Subcontractors and their agents and employees, and other persons performing any of the Work under a contract with the Contractor.

8. The Contractor shall review, approve and submit all Product Data and Samples required by the Contract Documents. The Work shall be in accordance with approved submittals.

9. The Contractor at all times shall keep the premises free from accumulation of waste materials or rubbish caused by his operations. At the completion of the Work he shall remove all his waste materials or rubbish from and about the Project as well as his tools, construction equipment, machinery and surplus materials.

10. The Contractor shall pay all royalties and license fees. He shall defend all suits or claims for infringement of any patent rights and shall save the County harmless from loss on account thereof.

11. The Contractor shall confine operations at the site to areas permitted by law, ordinances, permits, the Contract documents and the County's representative including storage of any materials or equipment.

12. The Contractor shall promptly correct any Work rejected by the County as defective or as failing to conform to the Contract Documents whether observed before or after Substantial Completion and whether or not fabricated, installed or completed, and shall correct any Work found to be defective or nonconforming within a period of one year from the Date of Substantial Completion of the Contract or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents. The provisions of this Article apply to Work done by Subcontractors or Support Services as well as to Work done by direct employees of the Contractor. Corrections shall be made at no expense to the County.

13. Safety:
    a. The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work. The Contractor shall give all notices and comply with the applicable laws,

ordinances, rules, regulations, and orders of any public authority bearing on the safety of persons and property and on their protection from damage, injury or loss. The Contractor shall take all reasonable steps to minimize inconvenience to users of the site and shall take all reasonable precautions for the safety to, and shall provide all reasonable protection to prevent damage, injury, or loss to:

i. All employees on the work site and all other persons, including visitors and passersby who may be affected by the work;
ii. All the work and all materials and equipment to be incorporated therein; and
iii. All property at the site or adjacent thereto.

b. The Contractor shall designate a responsible member of the Contractor's organization at the site who shall be assigned the duty of the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the County. This person will also work closely with the County's work superintendent on safety issues and attend regular safety discussions as set by the County's work superintendent.

c. In the event the County's superintendent or his designee notifies the Contractor's superintendent of any unsafe conditions or practices, the Contractor shall immediately take all actions required under paragraph 14a to ensure the safety of the work. If the condition or practice continues to present an imminent hazard, the County shall have the authority to stop the work until the condition has been remedied at no expense to the County. In no event shall the County be responsible for ensuring the safety of the work or for remedying the unsafe condition.

14. Liabilities: The Contractor shall promptly remedy all loss or damage to any property or persons caused in whole or in part by the Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or by any one for whose acts or omissions any of them may be liable. These obligations are in addition to any other obligations under this contract.

15. Performance Bond and Labor and Materials Bond:

a. Prior to the execution of the Contract by the County, the Contractor shall furnish and deliver to the County a Performance Bond and a Labor and Materials Payment Bond acceptable to the County, in a sum equal to the nearest integral of One Hundred Dollars ($100) in excess of the Contract price, duly executed by a Corporate Surety qualified and licensed to do business in Colorado and maintaining a general agent therein. Such bond shall comply with the provisions of Section 38-26-106, CRS. **Such bonds are only required if the amount of the contract price is in excess of Fifty Thousand Dollars ($50,000).**

b. Unless otherwise specified in the Bidding Documents, the bonds shall be written in the form AIA Documents A312, Performance Bond and Labor and Material Payment Bond.

c. The Bidder shall require the Attorney-in-Fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of his Power of Attorney.

16. No Fumes Clause:
The use of any product that causes fumes or irritants to permeate through or into the building and would cause a reasonable person physical distress or discomfort, such that it would be necessary to vacate users of the building, is strictly prohibited during business hours. Violators will be subject to a $5,000.00 per day fine for noncompliance. Any exception to this will require written approval from the County's Representative. The Contractor and County acknowledge and agree that the liquidated damages specified herein are reasonable in amount and are not disproportionate to anticipated actual damages. The County shall have the right to deduct liquidated damages from any amount due or that may become due to the Contractor, or to collect such liquidated damages from the Contractor or its surety.

C. WORK BY OWNER OR BY SEPARATE CONTRACTORS

1. The Owner reserves the right to perform work related to the Project with his own forces, and to award separate contracts in connection with other portions of the Project or other work on the site under these or similar conditions of the Contract. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, he shall make such claims as provided below.

2. Any claim for an increase or decrease in the Contract Price shall be based on written notice delivered by the party making the claim to the other party promptly (but in no event later than thirty days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered within sixty days after such occurrence and shall be accompanied by claimant's written statement that the amount claimed covers all known amounts (direct, indirect and consequential) to which the claimant is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Price shall be determined by OWNER if OWNER and CONTRACTOR cannot otherwise agree on the amount involved. No claim for an adjustment in the Contract Price will be valid if not submitted in accordance with this paragraph.

3. Any claim for an extension in the Contract Time shall be based on written notice delivered by the party making the claim to the other party promptly (but in no event later than thirty days) after the occurrence of the event giving rise to the claim. Notice of the extent of the claim with supporting data shall be delivered within sixty days after such occurrence and shall be accompanied by the claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant has reason to believe it is entitled as a result of the occurrence of said event. All claims for adjustment in the Contract Time shall be determined by OWNER if OWNER and CONTRACTOR cannot otherwise agree. No claim for an adjustment in the Contract Time will be valid if not submitted in accordance with the requirements of this paragraph.

4. The Contractor shall afford the Owner and separate contractor's reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work, and shall connect and coordinate his Work with theirs as required by the Contract Documents.

5. Any costs caused by defective or ill-timed work shall be borne by the party responsible therefore.

D. CHANGES IN THE WORK

1. The County may order additions, deletions, or modifications in the Work by issuing a change order signed by its authorized representatives. These changes will not invalidate the Contract; however, the Contract sum and Contract time will be adjusted accordingly by unit prices or by negotiated amount where unit prices are not provided.

2. The Contract sum and the Contract time may be changed only by Change Order.

3. The cost or credit to the County from a change in the Work shall be determined by mutual agreement.

4. Questions concerning changes, modifications and other construction problems are to be submitted to the County for interpretations.

E. SCHEDULING

1. Work is to begin after the County has notified the Contractor to proceed, and a work schedule has been agreed to by the County and Contractor. The County and Contractor shall each have copies of this schedule.

2. The Contractor shall promptly inform the County of items which will not be delivered or accomplished according to the initial schedule.

3. If the Contractor is delayed at any time in the progress of the Work by changes ordered in the Work, by labor disputes, fire, unusual delay in transportation, adverse weather conditions not reasonably anticipatable, unavoidable casualties, or any causes beyond the Contractor's control, or by any other cause which the County determines may justify the delay, then the Contract Time shall be extended by Change Order for such reasonable times as the County may determine.

F. PROGRESS PAYMENTS

1. If this contract is for one hundred fifty thousand dollars ($150,000) or less, partial payments shall be authorized by the County for work completed, if the Contractor is performing satisfactorily. Partial payments will be made based upon invoices submitted by the Contractor and certified by the County. Ten percent (10%) of each amount certified by the County shall be retained by the County until final payment is made. The Contractor shall make partial payments to his Subcontractors in the same manner as the County pays him, provided the Subcontractor is performing satisfactorily.

2. If this contract is for more than one hundred fifty thousand dollars ($150,000), partial payments of compensation due under this contract are subject to the provisions of Section 24-91-101, et. seq. CRS. If this contract exceeds One Hundred Fifty Thousand Dollars ($150,000), partial payments shall be authorized by the County for work completed, based upon invoices submitted by the Contractor, if the Contractor is performing satisfactorily. Five percent (5%) of the calculated value of any work completed shall be retained until work is completed, The withheld percentage of the contract price of any such work, improvement, or construction shall be retained until the contract is completed satisfactorily and finally accepted by the public entity. If the public entity finds that satisfactory progress is being made in all phases of the contract, it may, upon written request by the Contractor, authorize payment from the withheld percentage. Before such payment is made, the public entity shall determine that satisfactory and substantial reasons exist for the payment and shall require written approval from any surety furnishing bonds for the contract work. The Contractor shall make partial payments of the amount due to each his subcontractors in the same manner as the public entity is required to pay the Contractor under this statue, provided that the subcontractor is satisfactorily performing under his contract with the Contractor.

3. If it becomes necessary for the County to take over the completion of any contract, all of the amounts owing the contractor, including the withheld percentage, shall be applied: First, toward the cost of completion of the contract; second, toward performance of the public entity's withholding requirement set forth in section 38-26-107, C.R.S.; third, to the surety furnishing bonds for the contract work, to the extent such surety has incurred liability or expense in completing the contract work or made payments pursuant to section 38-26-106, C.R.S.; then, to the contractor. Such retained percentage as may be due any contractor shall be due and payable as provided by section 38-26-107,C.R.S.

4. Payments may be withheld on account of:
   a. defective work not remedied;
   b. claims filed;
   c. failure of the Contractor to make payments properly to Subcontractors or for labor, materials, or equipment;
   d. failure to carry out the Work in accordance with the Contract Documents; or
   e. failure to keep the designated superintendent on the site.
   f. failure to obtain any necessary permits or licenses necessary to carry out the Work under this Contract.

G. PREREQUISITES TO SUBSTANTIAL COMPLETION

1. Submit specific warranties, workmanship/maintenance bonds, maintenance agreements, final certificates and similar documents.

2. Furnish a list giving the names, addresses and phone numbers of all subcontractors and materials suppliers who provided labor and/or materials for the work, with identification of the labor and/or materials provided.

3. Obtain and submit releases enabling Owner's full use of the work and access to services and utilities, including occupancy permits, and similar releases.

4. Submit Record Drawings, maintenance manuals, operating instructions, and similar final records information.

5. Deliver tools, spare parts, extra stocks of materials, and similar physical items to Owner.

6. Make final change-over of locks and transmit keys to Owner.

7. Complete startup testing of systems, and instructions of Owner's operating/maintenance personnel. Discontinue (or change over) and remove from project site temporary facilities and services, along with construction tools and facilities, mock-up, and similar elements.

8. Complete final cleanup requirements.

H. SUBSTANTIAL COMPLETION

The Work (or a specified part thereof) has progressed to the point where, in the opinion of OWNER as evidenced by OWNER'S definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it was intended; or if there be no such certificate issued, when final payment is due in accordance with paragraph N of these GENERAL CONDITIONS TO BOULDER COUNTY BUILDING CONSTRUCTION CONTRACT. The terms "substantially complete" and "substantially completed" as applied to any Work refer to Substantial Completion thereof.

I. SUBSTANTIAL COMPLETION PROCEDURES

1. When CONTRACTOR considers the entire Work ready for its intended use CONTRACTOR shall notify OWNER in writing that the entire Work is substantially complete (except for items specifically listed by CONTRACTOR as incomplete) and request that OWNER issue a certificate of Substantial Completion.

2. Within a reasonable time thereafter, OWNER and CONTRACTOR shall make an inspection of the Work to determine the status of completion.

3. If OWNER does not consider the Work substantially complete, OWNER will notify CONTRACTOR in writing giving the reasons therefore.

4. If OWNER considers the Work substantially complete, OWNER will prepare and deliver to CONTRACTOR a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment.

    a. OWNER will within fourteen days execute and deliver to CONTRACTOR a definitive certificate of Substantial Completion with a list of items to be completed or corrected reflecting any changes from the tentative certificate.

    b. At the time of delivery of the tentative certificate of Substantial Completion OWNER will deliver to CONTRACTOR a written recommendation as to division of responsibilities pending final payment between OWNER and CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities, insurance and warranties. Unless CONTRACTOR objects in

writing and so informs OWNER prior to OWNER'S issuing the definitive certificate of Substantial Completion, OWNER'S aforesaid recommendation will be binding on OWNER and CONTRACTOR until final payment.

5. OWNER shall have the right to exclude CONTRACTOR from the Work after the date of Substantial Completion, but OWNER shall allow CONTRACTOR reasonable access to complete or correct items on the tentative list.

J. LIENS

No Mechanics lien may be held against a publicly owned building in the State of Colorado. Protections are limited to those set out below.

K. DEDUCTIONS FOR UNCORRECTED WORK

If the County determines that there is a need to correct work which has not been performed in accordance with the Contract, an equitable deduction from the Contract price may be authorized by change order.

L. ACCESS TO WORK

The County and any architect/engineer retained by the County shall at all times have access to the work.

M. FINAL PAYMENT

1. Within ten (10) days after the Contractor's written declaration of completion of the Work, the County will make a final inspection thereof to determine whether the Work has been completed in accordance with the Contract Documents. If a list of deficiencies results from such final inspection, the Contractor shall promptly rectify all items appearing thereon, before final payment will be made. When the County indicates acceptance of the Work, the Contractor may requisition final payment, including retainage on account of the Contract price.

2. Final payment is subject to the provisions of Section 38-26-107, CRS. Any proposed final settlement for this work shall be duly advertised at least ten (10) days prior thereto by publication at least twice in a public newspaper of general circulation. Any creditor that has furnished labor, materials, team hire, sustenance, provisions, provender, or other supplies used or consumed on this project by the Contractor or its Subcontractors, or that supplies rental machinery, tools, or equipment to the extent used in the prosecution of the work, whose claim therefore has not been paid by the Contractor or the Subcontractor at any time up to and including the time of final settlement, may file with the County a verified statement of the amount due and unpaid. Such amounts claimed shall thereafter be retained by the County from final settlement pursuant to the provisions of the statute.

3. In any event, final payment shall not be authorized until all inspections have been completed, and all work has been completed.

4. The making of final payments shall constitute a waiver of all claims by the County except those arising from:

a. unsettled claims
b. faulty or defective Work appearing after Substantial Completion
c. failure of the Work to comply with the requirements of the Contract Documents
d. terms of any special warranties required by the Contract Documents.

5. The acceptance of final payment shall constitute a waiver of all claims by the Contractor except those previously made in writing and identified by the Contractor as unsettled at the time of the final Application for Payment.

N. TESTS

The Contractor shall provide such equipment and facilities as the Architect may require for conducting field tests and for collecting and forwarding samples. The Contractor shall not use any material or equipment represented by samples found to be unacceptable. The Owner shall pay testing laboratory costs for materials testing. The Contractor shall give the Architect and testing laboratory timely notice for required tests.

O. MEASUREMENTS

Before ordering any materials or doing any work, the Contractor shall verify all measurements at the project and shall be responsible for the correctness of same. No extra charge or compensation shall be allowed on account of difference between actual dimensions and the measurements indicated on the Drawings. Any difference that may be found shall be submitted to the Owner for consideration before proceeding with the work. The Architect and Owner shall not be responsible for the scaling of Drawings.

END OF GENERAL CONDITIONS