

BID ADDENDUM 1

SBCCD

114 S. Del Rosa Drive
San Bernardino, CA 92408
909.382.4000

Distribution:

☒ Owner
☒ Plan Holders

☐ Architect
☐ Plan Exchanges

PROJECT:

ADDENDUM 1

Crafton Hills College

NIB # 03-1819-01 - Print Shop Tenant Improvements at BL 14

OWNER: San Bernardino Community College District

DATE OF ISSUANCE: 11/13/2018

THIS ADDENDUM HAS BEEN PREPARED TO CLARIFY, MODIFY, DELETE, OR ADD TO THE DRAWINGS AND/OR SPECIFICATIONS FOR THE ABOVE REFERENCED PROJECT. THE ITEMS LISTED HEREIN SUPERSEDE DESCRIPTIONS PRIOR TO THE DATE LISTED ABOVE. ALL CONDITIONS NOT SPECIFICALLY REFERENCED HERE SHALL REMAIN THE SAME. IT IS THE OBLIGATION OF THE PRIME TRADE CONTRACTOR TO MAKE SUBCONTRACTORS AWARE OF ANY ITEMS HEREIN THAT MAY AFFECT BIDS.

THE OFFICIAL BID TIME AND DATE IS: 10:00 a.m. on November 21, 2018.

To:

San Bernardino Community College District

Attn: Ernie Loera

114 South Del Rosa Drive

San Bernardino, CA 92408

Project: Crafton Hills College

NIB # 03-1819-01 - Print Shop Tenant Improvements at BL 14

- Replace Bid Bond 00 30 03 (all pages) with the attached updated Bid Bond which corrects the Project Name.
- Replace Exhibit E in its entirety with the attached updated Plans. These plans contain the following note under the Architectural Stamp Legend: "Bid Set Not Approved". These updated plans are also dated November 2, 2018.
- Replace Exhibit F in its entirety with the attached updated Technical Specifications noted as "Bid Set" and Dated November 2, 2018.

REFERENCE DOCUMENT(S) ATTACHED:

- Mandatory Job Walk Sign in sheet.
- Exhibit A Specification 00 30 03 Bid Form
- Exhibit E – Addendum 1 Plans
- Exhibit F – Addendum 1 Technical Specifications

- End of Addendum No. 1 -

BID ADDENDUM 1



Mandatory Pre- Bid Conference: 11/13/2018
@10:00 am

Location: CHC

[illegible]



Mandatory Pre- Bid Conference: 11/13/2018
@10:00 am

Location: CHC

[illegible]

EXHIBIT A

November 2018

SECTION 00 30 03 – BID BOND

NIB # 03-1819-01 Print Shop Tenant Improvements at BL 14

KNOW ALL MEN BY THESE PRESENTS that we, the undersigned, (hereafter called “Principal”), and _____ (hereafter called “Surety”), are hereby held and firmly bound unto San Bernardino Community College District (hereafter called “Owner”) in the sum of (\$ _____)

TOTAL PRICE IN WORDS

_____ DOLLARS for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, successors, and assigns.

SIGNED this _____ day of _____, 201_.

The condition of the above obligation is such that whereas the Principal has submitted to the Owner a certain Bid, attached hereto and hereby made a part hereof, to enter into a contract in writing for the construction of the Lighting Tubes at the District Office (DO)

NOW, THEREFORE,

- a. If said Bid is rejected, or
- b. If said Bid is accepted and the Principal executes and delivers a contract or the attached Agreement form within five (5) days after acceptance (properly completed in accordance with said Bid), and furnishes bonds for his faithful performance of said Contract and for payment of all persons performing labor or furnishing materials in connection therewith,

then this obligation shall be void; otherwise, the same shall remain in force and effect. Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration, or addition to the terms of the contract, or the call for bids, or the work to be performed there under, or the specifications accompanying the same, shall in anyway affect its obligation under this bond, and it does hereby waive notice of any such change, extension of time, alteration, or addition to the terms of said contract, or the call for bids, or the work, or to the specifications.

In the event suit is brought upon this bond by the DISTRICT and judgment is recovered, the Surety shall pay all costs incurred by the DISTRICT in such suit, including without limitation, attorneys’ fees to be fixed by the court, even if such fees exceed the penal sum of the bond.

November 2018

IN WITNESS WHEREOF, Principal and Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, on the day and year first set forth above.

PRINCIPAL:

ATTEST: (if individual, two witnesses are required)

By: _____

By: _____

Title: _____

Title: _____

ATTEST: (if corporation)

By: _____

Title: _____

(Corporate Seal)

SURETY:

ATTEST: (if individual, two witnesses are required)

By: _____

By: _____

Title: _____

Title: _____

ATTEST: (if corporation)

November 2018

By: _____

Title: _____

(Corporate Seal)

IMPORTANT: THIS IS A REQUIRED FORM

Surety companies executing bonds must possess a certificate of authority from the California Insurance Commissioner authorizing them to write surety insurance defined in California Insurance Code section 105, and if the work or Project is financed, in whole or in part, with federal, grant, or loan funds, it must also appear on the Treasury Department's most current list (Circular 570 as amended).

Any claims under this bond may be addressed to:

(Name and Address of Surety)

(Name and Address of agent or representative for service of process in California if different from above)

(Telephone Number of Surety and agent or representative for service of process in California)

END OF SECTION

EXHIBIT E

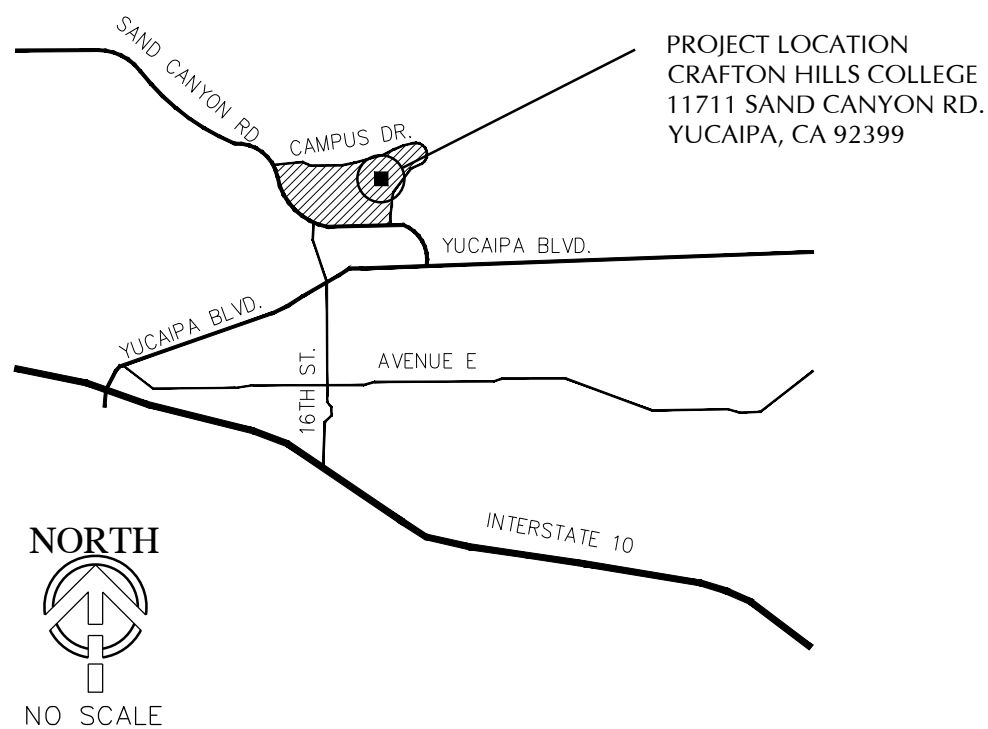
Print Shop Relocation to CHC Plans

SAN BERNARDINO COMM. COLL. DISTRICT

CRAFTON HILLS COLLEGE

PRINT SHOP TENANT IMPROVEMENTS AT BL14

VICINITY MAP



PROJECT SCOPE

TENANT IMPROVEMENTS TO AN (E) MODULAR BUILDING TO ACCOMMODATE THE DISTRICT'S IN-HOUSE PRINT SHOP.

BID INSTRUCTIONS

BIDDING DOCUMENTS ARE NOT DSA-APPROVED AND THEREFORE SUBJECT TO CHANGE. USE OF UNAPPROVED DOCUMENTS FOR CONSTRUCTION ARE AT OWNER'S SOLE RISK. ARCHITECT AND CONSULTANTS ARE NOT LIABLE FOR USE OF UNAPPROVED DOCUMENTS.

DEFERRED APPROVALS

NONE.

STATEMENT OF P.O.T. UPGRADES

DESIGN PROFESSIONAL IN GENERAL RESPONSIBLE CHARGE STATEMENT: THE POT IDENTIFIED IN THESE CONSTRUCTION DOCUMENTS IS COMPLIANT WITH THE CURRENT APPLICABLE CALIFORNIA BUILDING CODE ACCESSIBILITY PROVISIONS FOR PATH OF TRAVEL REQUIREMENTS FOR ALTERATIONS, ADDITIONS AND STRUCTURAL REPAIRS. AS PART OF THE DESIGN OF THIS PROJECT, THE POT WAS EXAMINED AND ANY ELEMENTS, COMPONENTS OR PORTIONS OF THE POT THAT WERE DETERMINED TO BE NONCOMPLIANT 1) HAVE BEEN IDENTIFIED AND 2) THE CORRECTIVE WORK NECESSARY TO BRING THEM INTO COMPLIANCE HAS BEEN INCLUDED WITHIN THE SCOPE OF THIS PROJECT'S WORK THROUGH DETAILS, DRAWINGS AND SPECIFICATIONS INCORPORATED INTO THESE CONSTRUCTION DOCUMENTS. ANY NONCOMPLIANT ELEMENTS, COMPONENTS OR PORTIONS OF THE POT THAT WILL NOT BE CORRECTED BY THIS PROJECT BASED ON VALUATION THRESHOLD LIMITATIONS OR A FINDING OF UNREASONABLE HARDSHIP ARE SO INDICATED IN THESE CONSTRUCTION DOCUMENTS.

DURING CONSTRUCTION, IF POT ITEMS WITHIN THE SCOPE OF THE PROJECT REPRESENTED AS CODE COMPLIANT ARE FOUND TO BE NONCONFORMING BEYOND REASONABLE CONSTRUCTION TOLERANCES, THEY SHALL BE BROUGHT INTO COMPLIANCE WITH THE CBC AS A PART OF THIS PROJECT BY MEANS OF A CONSTRUCTION CHANGE DOCUMENT.

SHEET INDEX

GENERAL

G-001 TITLE SHEET
G-002 SITE PLAN & CODE ANALYSIS

ARCHITECTURAL

A-021 EXISTING/DEMO FLOOR PLAN & RCP
A-022 EXISTING/DEMO ROOF PLAN
A-201 PROPOSED FLOOR PLAN & RCP
A-202 PROPOSED ROOF PLAN & DETAILS
A-401 SECTIONS
A-501 EQUIPMENT & LAYOUT PLAN
A-502 EQUIPMENT SCHEDULE
A-601 INTERIOR ELEVATIONS
A-602 INTERIOR ELEVATIONS
A-621 FINISH SCHEDULE
A-801 DOOR SCHEDULE & DETAILS
A-811 DOOR DETAILS
A-901 DETAILS
A-902 DETAILS

STRUCTURAL

S-001 STRUCTURAL GENERAL NOTES
S-002 INSPECTION TABLES
S-101 TYPICAL DETAILS
S-102 TYPICAL DETAILS
S-201 FLOOR FRAMING/FOUNDATION PLANS
S-202 ROOF FRAMING PLAN
S-401 STRUCTURAL DETAILS

MECHANICAL

M-001 GENERAL NOTES, LEGEND AND SHEET INDEX
M-002 SCHEDULES
M-201 FLOOR PLAN
M-202 ROOF PLAN
M-501 CONTROLS
M-601 DETAILS
M-602 DETAILS
M-701 TITLE 24 COMPLIANCE FORMS

PLUMBING

P-001 GENERAL NOTES, LEGEND, AND SHEET INDEX
P-002 SCHEDULES
P-201 FIRST FLOOR PLAN
P-601 DETAILS

ELECTRICAL

E-001 GENERAL NOTES, LEGEND AND SHEET INDEX
E-002 FIRE ALARM, GENERAL NOTES, LEGEND AND SHEET INDEX
E-003 SCHEDULES
E-201 FIRST FLOOR LIGHTING PLAN
E-211 FIRST FLOOR POWER PLAN
E-221 FIRST FLOOR FIRE ALARM PLAN
E-231 FIRST FLOOR AUXILIARY POWER PLAN
E-232 ROOF AUXILIARY POWER PLAN
E-501 SINGLE LINE DIAGRAM
E-502 FIRE ALARM CALCULATIONS
E-601 DETAILS

GENERAL NOTES

- ALL WORK SHALL CONFORM TO 2016 EDITION TITLE 24 CALIFORNIA CODE OF REGULATIONS (CCR).
- CHANGES TO APPROVED DRAWINGS AND SPECIFICATIONS SHALL BE MADE BY AN ADDENDUM OR A CHANGE ORDER APPROVED BY THE DIVISION OF THE STATE ARCHITECT AS REQUIRED BY SECTION 4-338, PART 1, T24 CCR.
- A DSA CERTIFIED INSPECTOR WITH CLASS 1 SHALL BE EMPLOYED BY THE DISTRICT AND SHALL PROVIDE CONTINUOUS INSPECTION OF THE WORK. THE DUTIES OF THE INSPECTION ARE DEFINED IN SECTION 4-342, PART 1, T24, CCR. THE PROJECT INSPECTOR SHALL BE CERTIFIED BY DSA TO INSPECT.
- APPARENT DISCREPANCIES ON DRAWINGS AND/OR SPECIFICATIONS SHALL BE REPORTED TO THE ARCHITECT BEFORE PROCEEDING WITH THE WORK.
- ANY DIFFERENCE BETWEEN THE EXISTING CONSTRUCTION AS OBSERVED IN THE FIELD AND AS SHOWN ON THE DRAWING SHALL BE REPORTED TO THE ARCHITECT BEFORE PROCEEDING WITH THE WORK.
- THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO STARTING WORK. THE ARCHITECT SHALL BE NOTIFIED OF ANY DISCREPANCIES OR INCONSISTENCIES. THE CONTRACTOR IS RESPONSIBLE FOR CHECKING AND COORDINATING DIMENSIONS.
- IT SHALL BE THE RESPONSIBILITY OF THE GENERAL CONTRACTOR TO ENSURE THAT ALL APPLICABLE SAFETY LAWS ARE STRICTLY ENFORCED AND TO MAINTAIN A SAFE CONSTRUCTION PROJECT.
- IT SHALL BE THE RESPONSIBILITY OF THE GENERAL CONTRACTOR TO PROVIDE SUPERVISION OF THE CONSTRUCTION WORK TO ENSURE THAT IT IS BUILT IN CONFORMANCE WITH THE APPROVED PLANS AND SPECIFICATIONS. THE ARCHITECT WILL PROVIDE ONLY PERIODIC OBSERVATION OF THE WORK. SEE NOTE 3 FOR DSA INSPECTION REQUIREMENTS.
- ANY DAMAGE DONE TO THE EXISTING CONSTRUCTION DURING THE COURSE OF THIS WORK SHALL BE REPLACED BY THE CONTRACTOR AT THE CONTRACTOR'S EXPENSE WITH NO ADDITIONAL COST TO THE OWNER.
- GRADING PLANS, DRAINAGE IMPROVEMENTS, ROAD & ACCESS REQUIREMENTS AND ENVIRONMENTAL HEALTH CONSIDERATIONS SHALL COMPLY WITH ALL LOCAL ORDINANCES.
- CUTTING, BORING, SAWCUTTING OR DRILLING THROUGH THE NEW OR EXISTING STRUCTURAL ELEMENTS TO BE DONE ONLY WHEN SO DETAILED IN THE DRAWINGS OR ACCEPTED BY THE ARCHITECT AND THE STRUCTURAL ENGINEER WITH THE APPROVAL OF DSA REPRESENTATIVE. ALL WELDING SHALL BE SPECIALLY INSPECTED BY AN AWS-CWI QUALIFIED INSPECTOR APPROVED BY DSA. ALL BRACING OF DUCTS AND PIPINGS SHALL BE INSTALLED IN ACCORDANCE WITH SMACNA GUIDELINES AND 2016 CBC REQUIREMENTS AS APPROVED BY DSA AND CONTAINED HEREIN. WHERE BRACING DETAILS ARE NOT SHOWN ON THE DRAWINGS OR IN THE GUIDELINES, THE FIELD INSTALLATION SHALL BE SUBJECT TO THE APPROVAL OF THE ARCHITECT, MECHANICAL ENGINEER AND FIELD ENGINEER. A COPY OF THE GUIDELINES PUBLISHED BY SMACNA AND APPROVED BY DSA SHALL BE PROVIDED BY THE CONTRACTOR AND KEPT ON THE JOB AT ALL TIMES.
- SHOULD ANY EXISTING CONDITIONS SUCH AS DETERIORATION OR NON-COMPLYING CONSTRUCTION BE DISCOVERED WHICH IS NOT COVERED BY THE DSA APPROVED DOCUMENTS WHEREIN THE FINISHED WORK WILL NOT COMPLY WITH TITLE 24, C.C.R., OR SEPARATE SET OF PLANS AND SPECIFICATIONS, DETAILING AND SPECIFYING THE REQUIRED REPAIR WORK SHALL BE SUBMITTED TO AND APPROVED BY DSA BEFORE PROCEEDING WITH THE REPAIR WORK.
- A DSA ACCEPTED TESTING LABORATORY DIRECTLY EMPLOYED BY THE SCHOOL DISTRICT SHALL CONDUCT ALL THE REQUIRED TESTS AND INSPECTIONS FOR THE PROJECT.
- ALL WORK (AS APPLICABLE) MUST MEET THE MANDATORY MEASURES OF THE 2016 CALIFORNIA GREEN BUILDING STANDARDS (CAL GREEN) CODE (TITLE 24, PART II).

APPLICABLE CODES

PARTIAL LIST OF APPLICABLE CODES AS OF January 1, 2017

2016 California Building Standards Administrative Code, Title 24 C.C.R.
2016 California Building Code (CBC), Title 24 C.C.R.
(2015 International Building Code of the International Code Council, with California Amendments)
2016 California Electrical Code (CEC), Title 24 C.C.R.
(2014 National Electrical Code of the National Fire Protection Association, NFPA)
2016 California Mechanical Code (CMC), Title 24 C.C.R.
(2015 Uniform Mechanical Code of the International Association of Plumbing and Mechanical Officials, IAPMO)
2016 California Plumbing Code (CPC), Title 24 C.C.R.
(2015 Uniform Plumbing Code of the International Association of Plumbing and Mechanical Officials, IAPMO)
2016 California Energy Code (CEC), Part 6, Title 24 C.C.R.
2016 California Fire Code, Title 24 C.C.R.
(2015 International Fire Code of the International Code Council)
2016 California Green Building Standards Code (CALGreen Code), Title 24 C.C.R.
2016 California Referenced Standards Code, Title 24 C.C.R.
Title 19 C.C.R., Public Safety, State Fire Marshal Regulations.

PARTIAL LIST OF APPLICABLE STANDARDS

NFPA 13	Automatic Sprinkler Systems	2016 Edition
NFPA 14	Standpipe Systems (CA Amended)	2016 Edition
NFPA 17A	Wet Chemical Extinguishing Systems	2017 Edition
NFPA 20	Stationary Pumps	2016 Edition
NFPA 24	Private Fire Service Mains (CA Amended)	2016 Edition
NFPA 72	National Fire Alarm and Signaling Code (CA Amended)	2016 Edition
NFPA 80	Fire Door and Other Opening Protectives	2016 Edition
NFPA 253	Critical Radiant Flux of Floor Covering	2015 Edition
NFPA 2001	Clean Agent Fire Extinguishing Systems	2015 Edition

Reference code section for NFPA standards – 2016 CBC (SFM) Chapter 35.
See Chapter 35 for State of California amendments to NFPA standards.



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PROJECT OWNER & TITLE

SAN BERNARDINO
COMMUNITY COLLEGE DIST.
PRINT SHOP T.I. AT
CRAFTON HILLS
COLLEGE BL 14
11711 SAND CANYON ROAD
YUCAIPA, CA 92399

SHEET TITLE

TITLE SHEET

OWNER CONTACT:

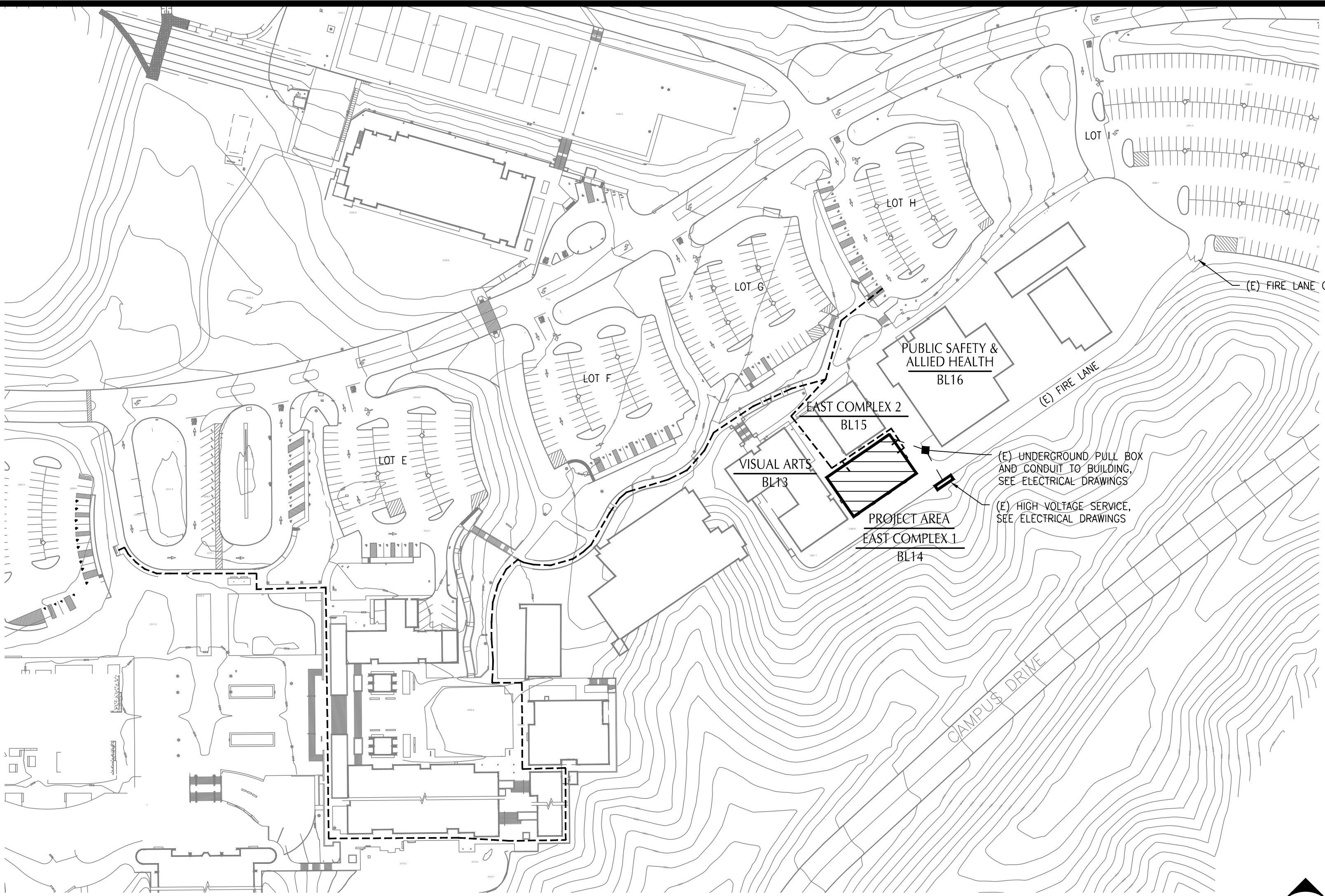
SAN BERNARDINO COMMUNITY COLLEGE DISTRICT
114 SOUTH DEL ROSA DRIVE
SAN BERNARDINO, CA 92408
(909) 382-4094
ATTN: HUSSAIN AGAH, DIRECTOR / FACILITIES, PLANNING & CONSTRUCTION

DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

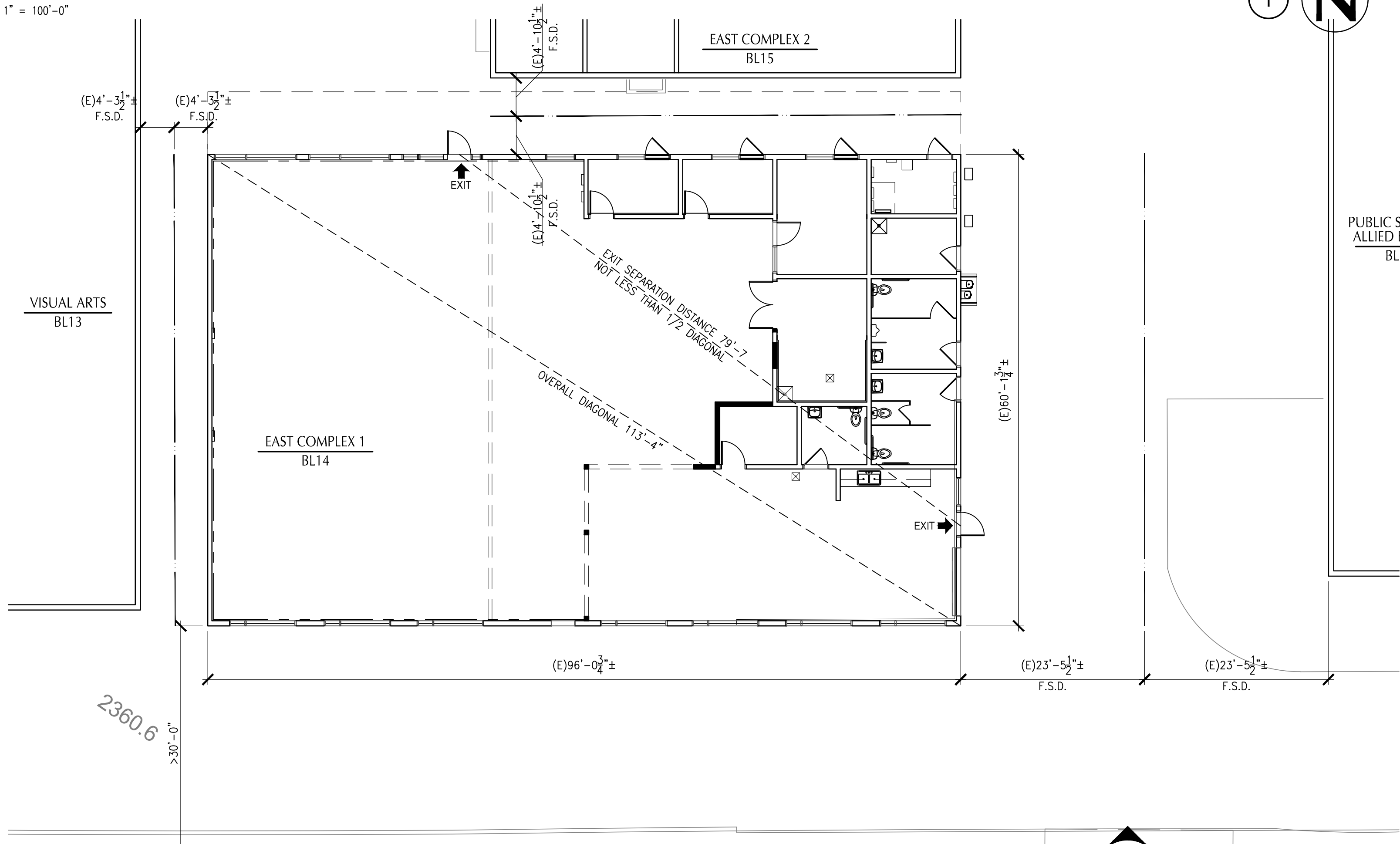
G-001

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____



SITE PLAN

SCALE: 1" = 100'-0"



CODE PLAN

SCALE: 3/32" = 1'-0"

EXISTING BUILDING DATA

BLDG	OCC. TYPE	CONST TYPE	NO. STORIES	NO. STORIES ALLOW.	SPRNKLR	BLDG HT.	ALLOW. BLDG. HT.	BLDG AREA	ROOF OH	TOTAL AREA	ALLOW. AREA
BL14	B	VB	1	2	NS	(E) 15'-6"±	40'-0"	5,760 SF	768 SF	6,528 SF	9,000 SF

LEGEND

----- ACCESSIBLE PATH OF TRAVEL



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SHEET TITLE

SITE PLAN & CODE
ANALYSIS

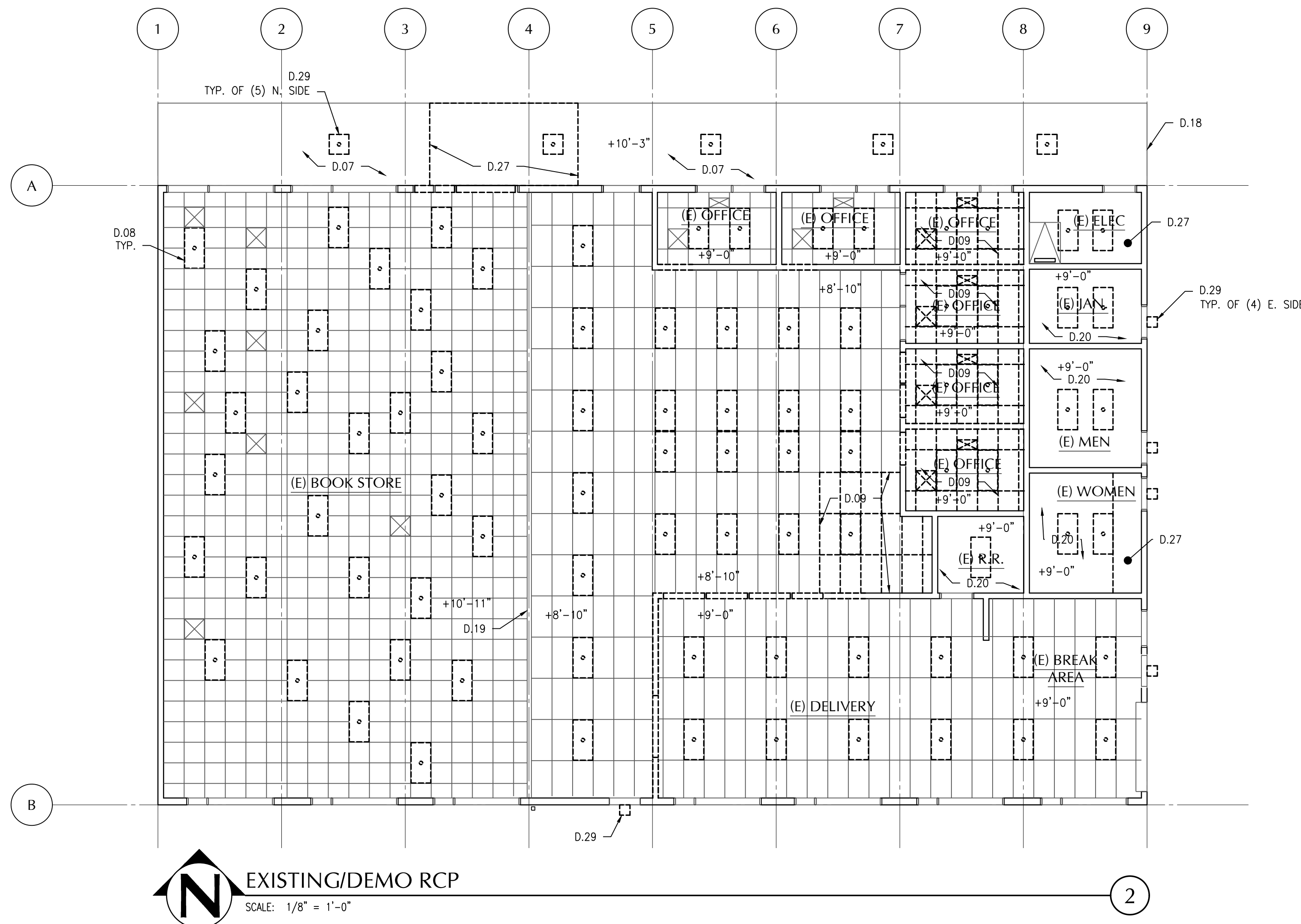
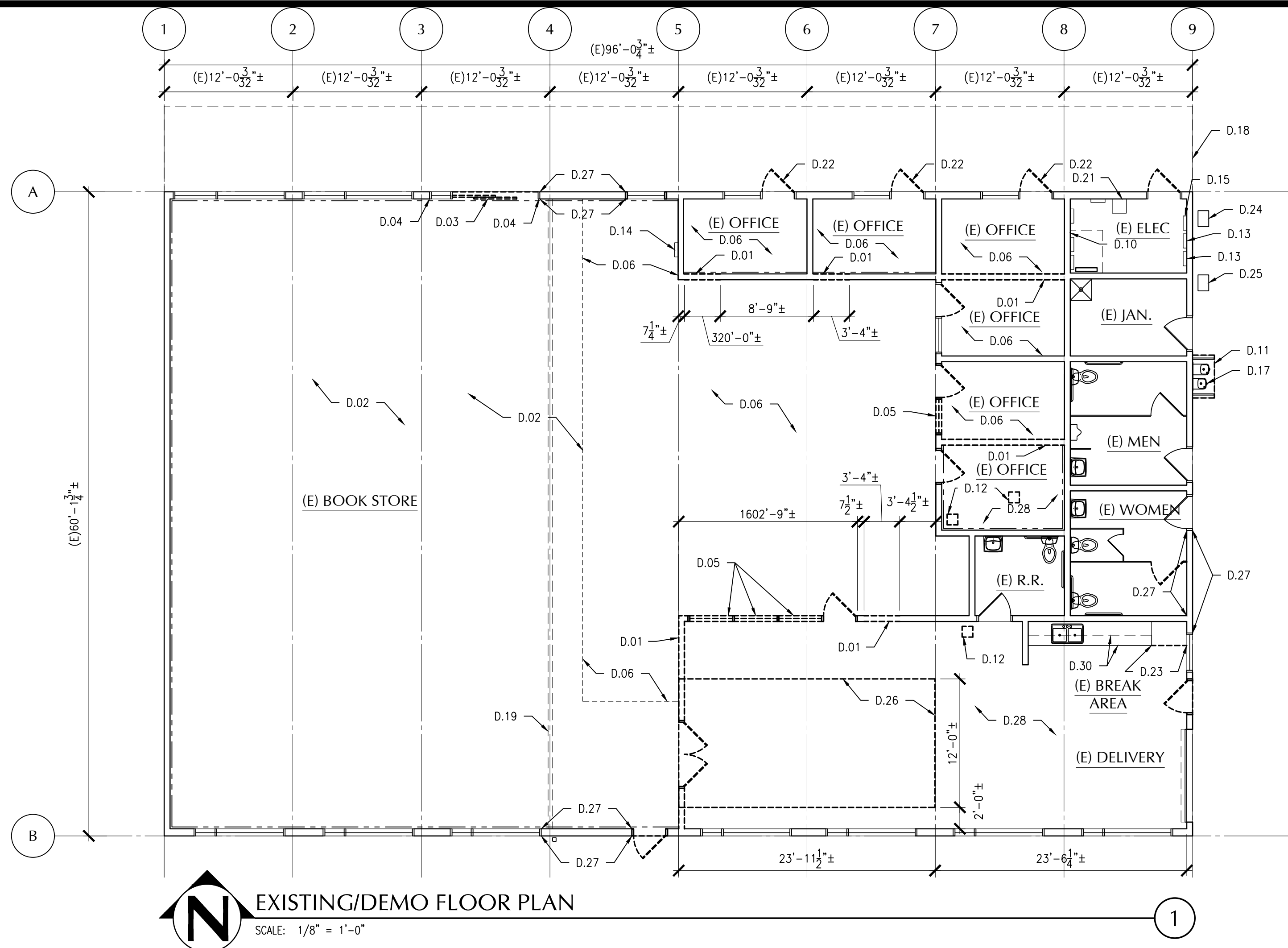
DRAWN BY: MH/QP

JOB NUMBER: 18116.03

SHEET NO.

G-002

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____



KEYNOTES

- D.01 (E) WALL, REMOVE
D.02 (E) VCT FLOORING/RUBBER BASE, REMOVE
D.03 (E) AUTOMATIC SLIDING GLASS DOOR, REMOVE
D.04 (E) STOREFRONT SYSTEM, TO REMAIN, PROTECT IN PLACE, TYP.
D.05 (E) WINDOW, REMOVE
D.06 (E) CARPET/RUBBER BASE, REMOVE
D.07 (E) METAL CEILING PANELS, TO REMAIN
D.08 (E) INTERIOR LIGHT FIXTURE, TO REMAIN U.N.O., PREP TO RECEIVE LED RETROFIT KIT, SEE ELECTRICAL DRAWINGS
D.09 (E) SUSPENDED ACOUSTIC TILE CEILING SYSTEM, REMOVE AS REQUIRED TO ACCOMMODATE WORK
D.10 (E) DAMAGED GYPSUM BOARD, REMOVE AT ENTIRE WALL, ABATE MOLD AS REQUIRED
D.11 (E) CONCRETE WALK, REMOVE AS REQUIRED TO ACCOMMODATE WORK
D.12 (E) CONCRETE DECK, ALTER/REMOVE AS REQUIRED TO ACCOMMODATE WORK
D.13 (E) ELECTRICAL PANEL, SEE ELECTRICAL DRAWINGS
D.14 (E) F.A. PANEL, TO REMAIN, SEE ELECTRICAL DRAWINGS
D.15 (E) HVAC CONTRALS PANEL, SEE MECHANICAL DRAWINGS
D.16 (E) LADDER AND ROOF ACCESS HATCH, TO REMAIN
D.17 (E) HI-LO DRINKING FOUNTAIN, TO REMAIN, REPAIR BUBBLERS AND LEAKING WASTE PIPE
D.18 (E) CANOPY, TO REMAIN
D.19 (E) SOFFIT OVERHEAD, TO REMAIN
D.20 (E) GYPSUM BOARD CEILING, TO REMAIN
D.21 (E) SERVER RACK
D.22 (E) DOOR, TO REMAIN, SEE A-201
D.23 (E) COUNTERTOP, REMOVE AS INDICATED, REPAIR EXPOSED EDGE W/ MATCHING LAMINATE
D.24 (E) GAS P.O.C., TO REMAIN
D.25 (E) WATER P.O.C., TO REMAIN
D.26 (E) OPENING IN FLOOR DECK, FIELD VERIFY EXTENTS
D.27 (E) EXPOSED STRUCTURE, FIELD VERIFY EXTENTS
D.28 (E) FLOOR PAINT/RUBBER BASE, REMOVE
D.29 (E) EXTERIOR LIGHT FIXTURE, REMOVE, SEE ELECTRICAL DRAWINGS
D.30 (E) CASEWORK, TO REMAIN, PROTECT IN PLACE

LEGEND

- (E) WALL, REMOVE
===== (E) WALL, TO REMAIN
===== (E) WALL, TO REMAIN, REMOVE INTERIOR WALL FINISH ONLY (ACOUSTIC PANEL O/ GYP. BD.)
--- (E) DOOR, REMOVE
--- (E) DOOR, TO REMAIN

GENERAL NOTES

- REMOVE (E) SECURITY SYSTEM, ACCESS SYSTEM, AND ALARM SYSTEM THROUGHOUT, SALVAGE TO OWNER
- REMOVE CASEWORK, FURNITURE, SHELVING, AND CHANNEL BOARD IN FORMER BOOKSTORE AND OFFICE AREAS, FIELD VERIFY SALVAGE ITEMS WITH DISTRICT PRIOR TO DEMOLITION
- REMOVE ALL LETTERING ON GLAZING, ROOM IDENTIFICATION SIGNAGE, LETTERING ON WALLS, AND DOOR SIGNAGE EXCEPT (E) "14 EAST 1" IDENTIFICATION ABOVE NORTH ENTRY DOOR
- (E) CEILING GRIDS TO REMAIN THROUGHOUT U.N.O.
- REMOVE (E) CEILING TILES ONLY THROUGHOUT
- REMOVE (E) FLOOR GLUE UNDERNEATH (E) VCT AND (E) CARPET, PREP SUFFICIENTLY TO RECEIVE CONCRETE FLOOR SEALER PER SEALER MFR. SPECIFICATIONS

PMSM
ARCHITECTS

19.6
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**EXISTING/DEMO
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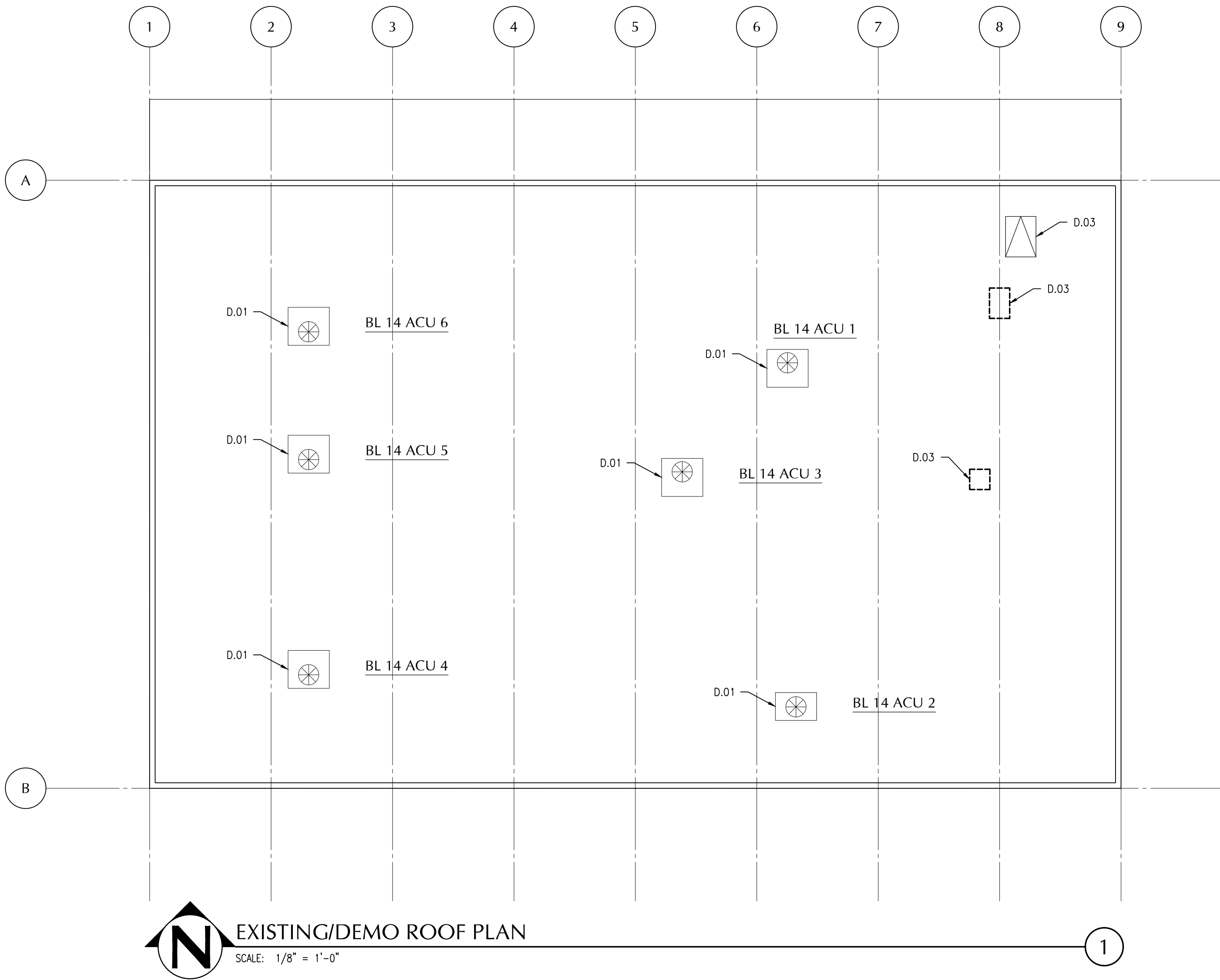
DRAWN BY: MH/QP

JOB NUMBER: 18116.03

SHEET NO.

A-021

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____



KEYNOTES

- D.01 (E) MECHANICAL UNIT, TO REMAIN
D.02 (E) ROOF ACCESS HATCH, TO REMAIN
D.03 (E) ROOFING, REMOVE/PREP AS REQUIRED TO ACCOMMODATE WORK



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SHEET TITLE

EXISTING/DEMO
ROOF PLAN

DRAWN BY: MH/QP JOB NUMBER: 18116.03

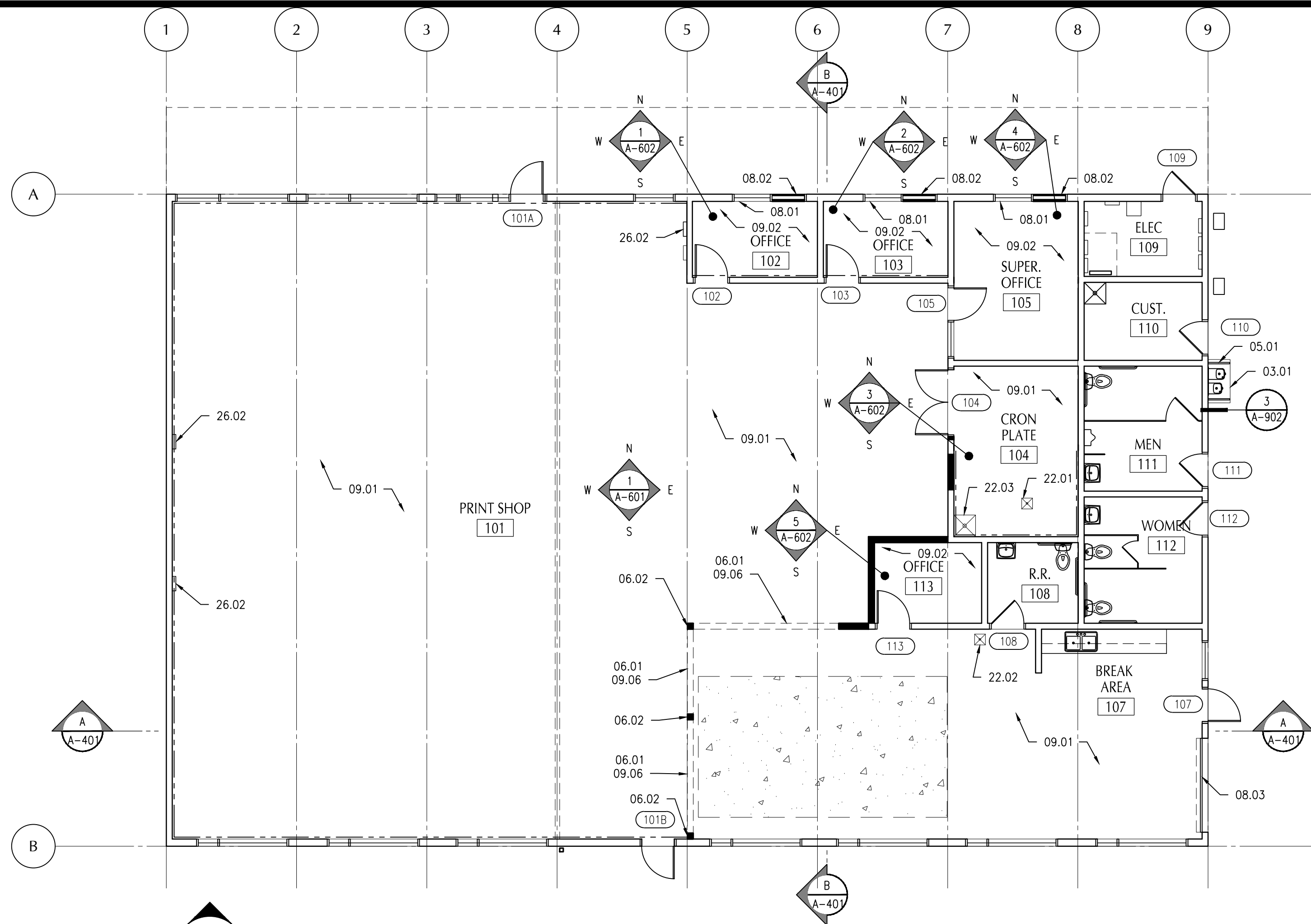
SHEET NO.

A-022

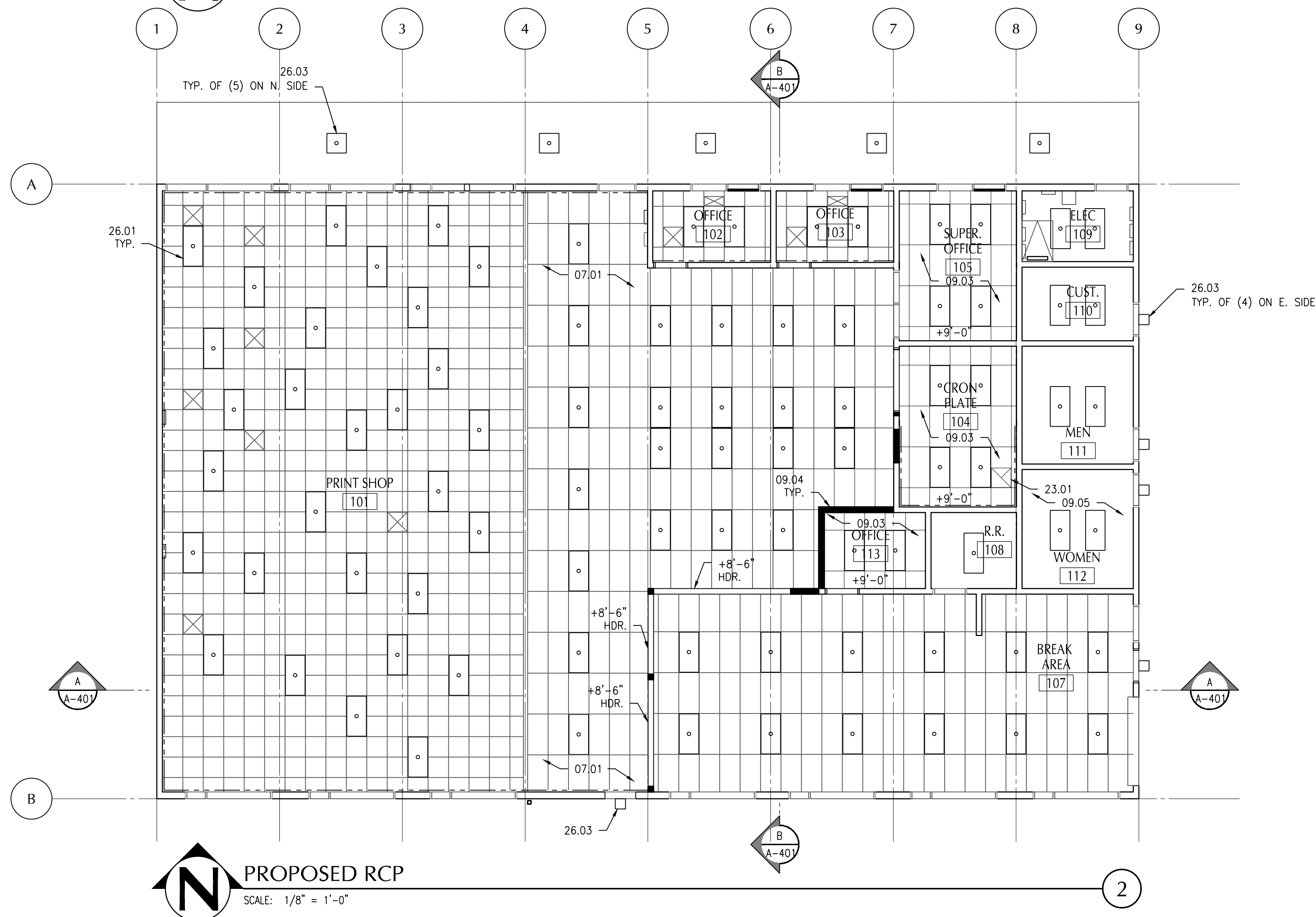
DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

GENERAL NOTES

1. PROTECT IN PLACE (E) ROOFING, (E) DRAINS, (E) EQUIPMENT, ETC.



PROPOSED FLOOR PLAN (EQUIPMENT & FURNITURE NOT SHOWN FOR CLARITY)
SCALE: 1/8" = 1'-0"



PROPOSED RCP
SCALE: 1/8" = 1'-0"

KEYNOTES

- 03.01 REPLACE CONCRETE PAVING, MATCH (E)
05.01 CANE DETECTION RAILS
06.01 HEADER OVERHEAD, SEE STRUCTURAL DRAWINGS
06.02 POST, SEE STRUCTURAL DRAWINGS, WRAP W/ GYP. BD.
07.01 REPLACE INSULATION BETWEEN JOISTS ABOVE CEILING WHERE MISSING, FIELD VERIFY EXTENTS
08.01 ROLLER SHADE
08.02 FIX DOOR IN PLACE, PROVIDE INTERIOR INFILL FRAMING AND INSULATION
08.03 (E) ROLL-UP DOOR, SERVICE/LUBE/CLEAN ROLLING MECHANISM, PROVIDE WEATHER STRIPPING AT BOTTOM
09.01 (E) CONCRETE FLOOR, SEAL
09.02 CARPET/RUBBER BASE
09.03 SUSPENDED ACOUSTICAL PANEL CEILING, SEE 1/A-901
09.04 ALTER (E) CEILING AS REQ'D. TO ACCOMMODATE WORK
09.05 GYP. BD. CEILING, REPLACE AS REQ'D.
09.06 REPAIR/REPLACE GYP. BD. AT HEADER AS REQ'D.
22.01 FLOOR SINK, SEE PLUMBING DRAWINGS
22.02 EYEWASH STATION, SEE PLUMBING DRAWINGS
22.03 SERVICE SINK, SEE PLUMBING DRAWINGS
23.01 EXHAUST FAN, SEE MECHANICAL DRAWINGS
26.01 INTERIOR LIGHT FIXTURE, SEE ELECTRICAL DRAWINGS
26.02 ELECTRICAL PANEL, SEE ELECTRICAL DRAWINGS
26.03 EXTERIOR LIGHT FIXTURE, SEE ELECTRICAL DRAWINGS

LEGEND

- (E) WALL, TO REMAIN
—— (E) WALL W/ (N) WALL FINISH (3/8" STD. GYP. BD. 0/ 5/8" TYPE. X GYP. BD.)
—— WALL
—— (E) DOOR, TO REMAIN
—— DOOR, SEE DOOR SCHEDULE
—— CONCRETE DECK INFILL, SEE STRUCTURAL DRAWINGS

GENERAL NOTES

1. ALL DOOR HARDWARE TO MATCH (E) CAMPUS STANDARDS (SCHLAGE EVEREST C). VERIFY LATEST CAMPUS STANDARD WITH DISTRICT.



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CONSULTANTS

MECHANICAL, ELECTRICAL,
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San Luis Obispo, CA 93405
TEL (805) 548-8600

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AGENCY APPROVAL

REVISIONS

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PROJECT OWNER & TITLE

SAN BERNARDINO
COMMUNITY COLLEGE DIST.
**PRINT SHOP T.I. AT
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COLLEGE BL 14**
11711 SAND CANYON ROAD
YUCAIPA, CA 92399

SHEET TITLE

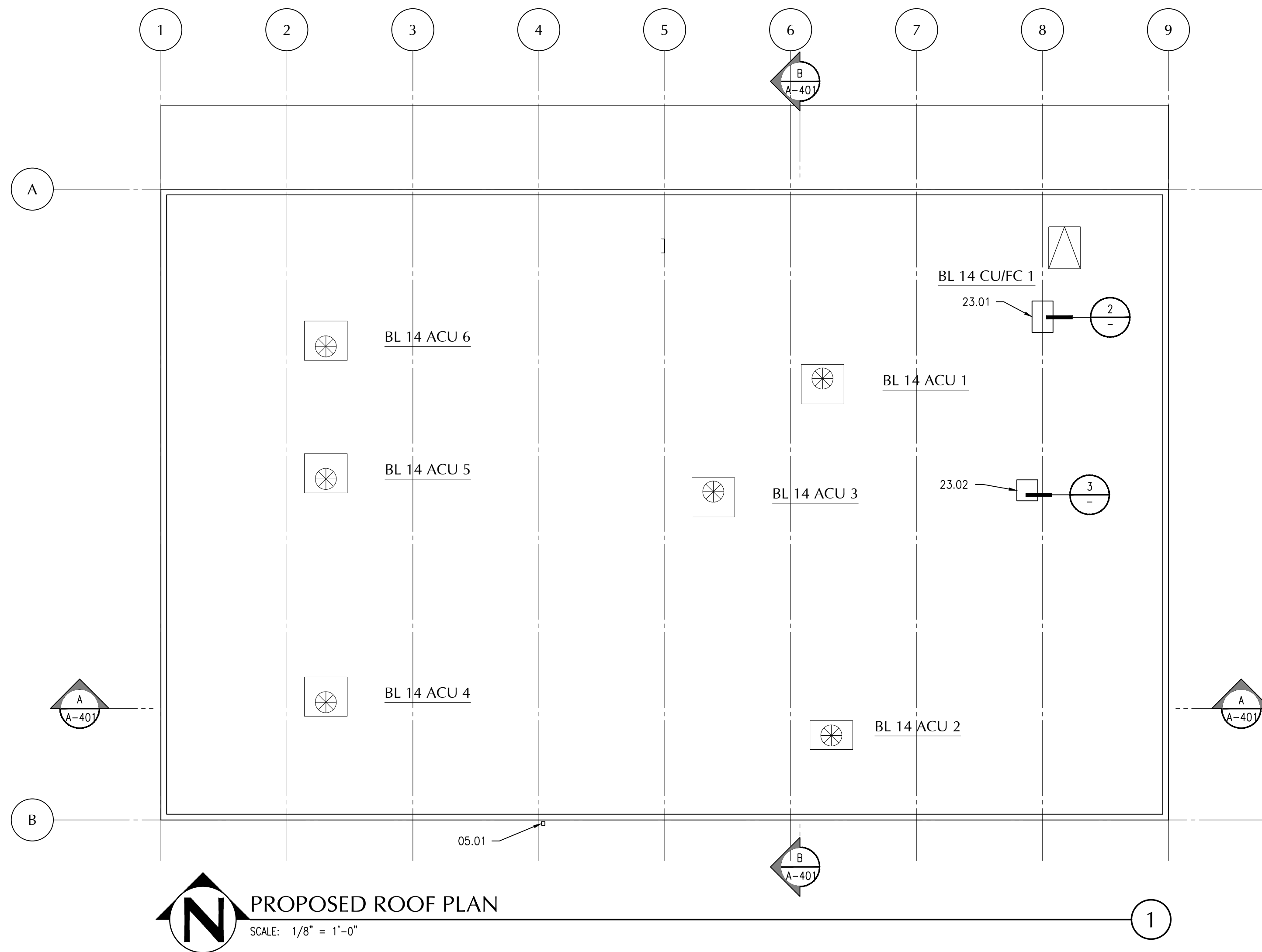
**PROPOSED FLOOR
PLAN & RCP**

DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

A-201

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____



KEYNOTES

05.01 REINSTALL (E) LEADERHEAD AND (E) DOWNSPOUT
23.01 MECHANICAL UNIT, SEE MECHANICAL DRAWINGS
23.02 EXHAUST FAN, SEE MECHANICAL DRAWINGS

GENERAL NOTES

1. PATCH/REPAIR ROOFING AS REQ'D. TO ACCOMMODATE WORK



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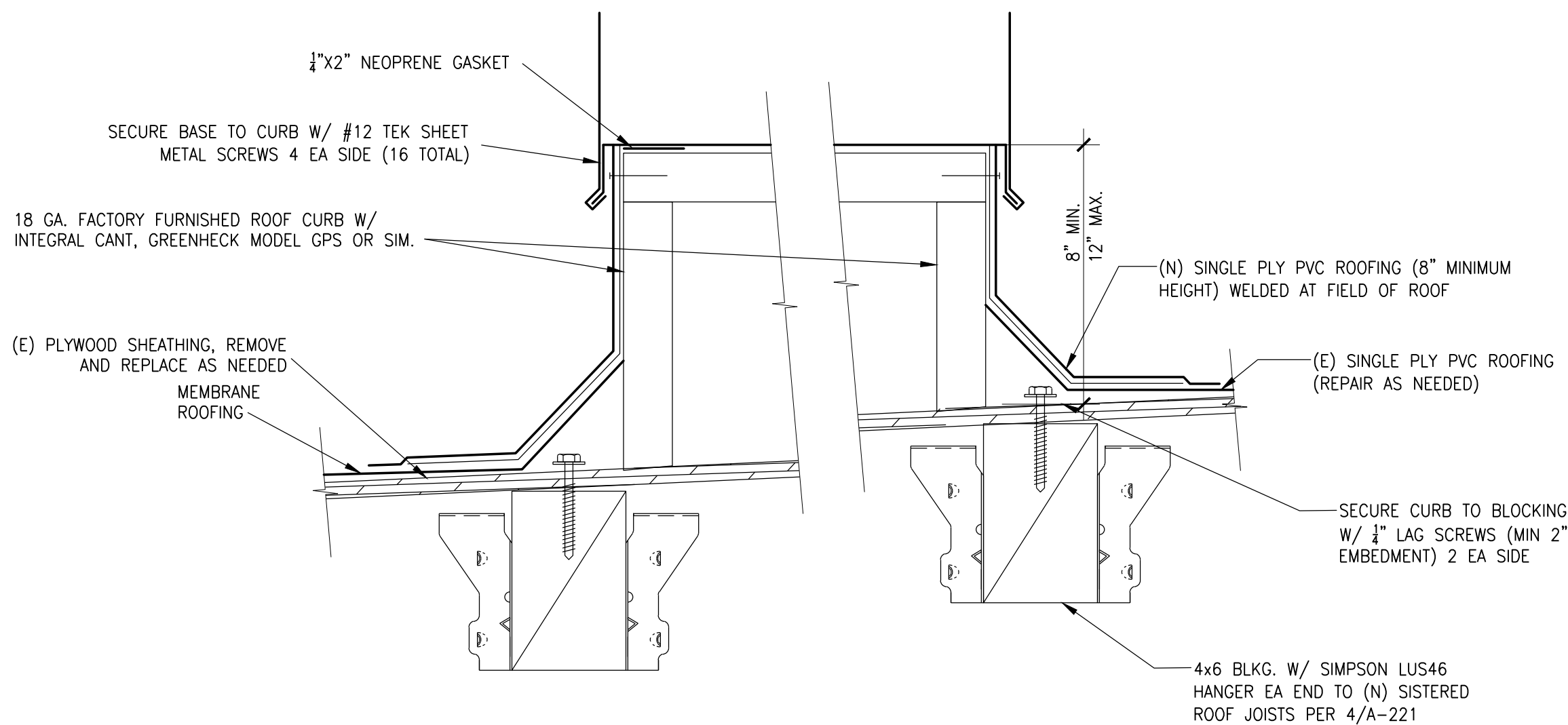
PROPOSED ROOF
PLAN & DETAILS

DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

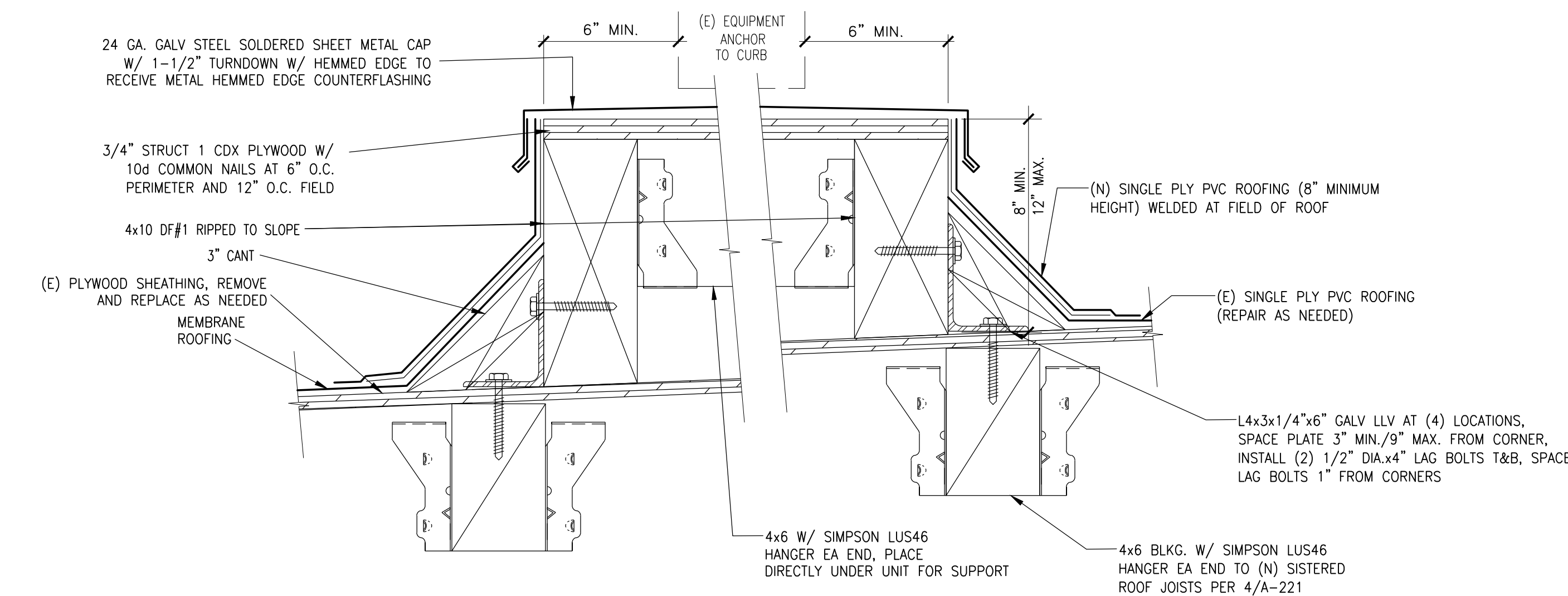
A-202

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____



EXHAUST FAN CURB

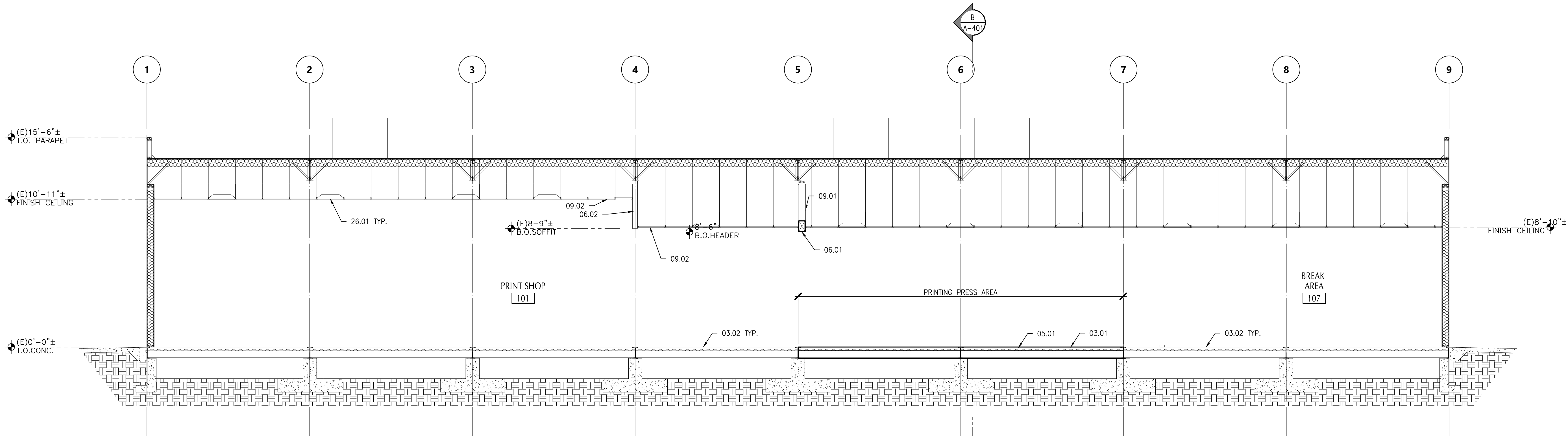
SCALE: 3" = 1'-0"



MECHANICAL EQUIPMENT CURB

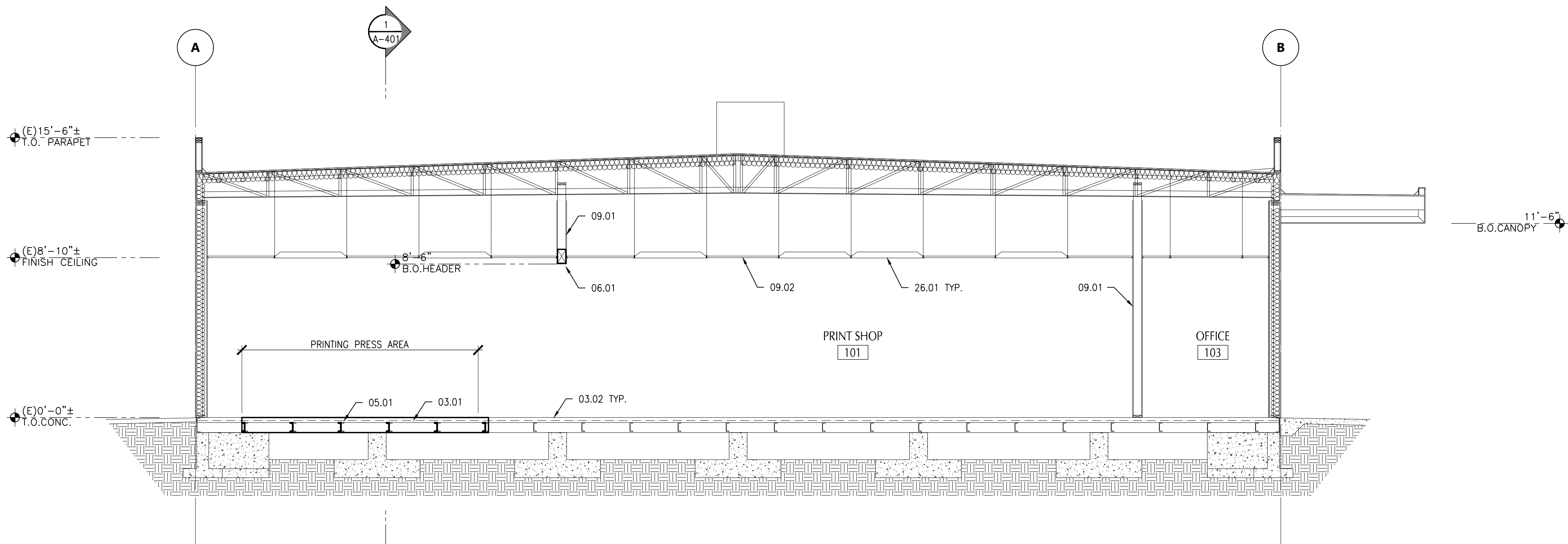
SCALE: 3" = 1'-0"

DRAWING NAME: H:\2018\181603 CHC DISTRICT PRINT SHOP T.L.CDS THROUGH CADRAWINGS\01 FILES\1816.03-A-401.DWG
PLOT DATE: Nov 12, 2018 - 6:26AM
PLOT BY: MHARTMAN



SECTION

SCALE: 1/4" = 1'-0"



SECTION

SCALE: 1/4" = 1'-0"

KEYNOTES

- 03.01 CONCRETE DECK INFILL, SEE STRUCTURAL DRAWINGS
03.02 (E) CONCRETE OVER METAL DECK, TO REMAIN U.N.O.
05.01 STEEL FLOOR FRAMING, SEE STRUCTURAL DRAWINGS
06.01 WOOD HEADER, SEE STRUCTURAL DRAWINGS
06.02 (E) SOFFIT, TO REMAIN
09.01 (E) WOOD PARTITION WALL, TO REMAIN
09.02 (E) SUSPENDED ACOUSTICAL PANEL CEILING, SEE 2/A-022 AND 2/A-201 FOR WORK
26.01 (E) LIGHT FIXTURE, TO REMAIN, SEE ELECTRICAL DRAWINGS FOR SCOPE OF WORK

GENERAL NOTES

1. REPLACE BATT INSULATION WHERE REMOVED TO CARRY OUT WORK.



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SHEET TITLE

SECTIONS

DRAWN BY: MH/QP

JOB NUMBER: 18116.03

SHEET NO.

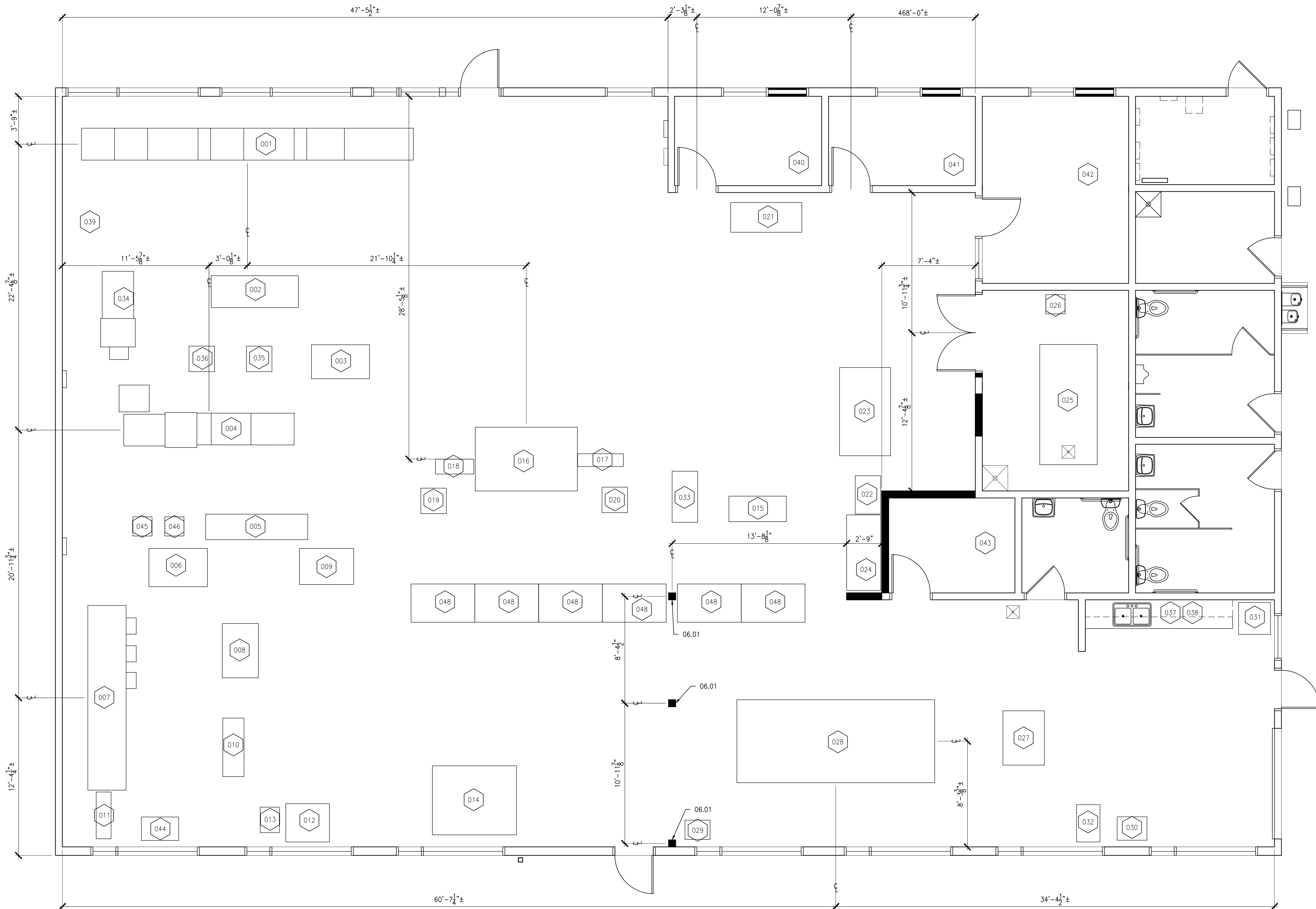
A-401

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

DRAWING NAME: IN:\2018\B1603 CHC DISTRICT PRINT SHOP T.I.CDS THROUGH CADRAWINGS\BLOT FILES\B16.03-A-501.DWG

PLOT DATE: Nov 12, 2018 - 6:24M

PLOT BY: HARTMAN



EQUIPMENT & LAYOUT PLAN
SCALE: 1/4" = 1'-0"

GENERAL NOTES

1. EQUIPMENT N.I.C.
2. FIELD VERIFY FINAL EQUIPMENT LAYOUT WITH DISTRICT PRIOR TO COMMENCEMENT OF WORK.

KEYNOTES

06.01. POST, SEE STRUCTURAL DRAWINGS



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SHEET TITLE

EQUIPMENT &
LAYOUT PLAN

DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

A-501

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

EQUIPMENT SCHEDULE FOR EQUIPMENT FLOOR PLAN, SEE SHEET A-501

ITEM TAG NUMBER	EQUIPMENT NAME AND DESCRIPTION	MANUFACTURER	PRODUCT MODEL NUMBER	NEW	EXISTING	QUANTITY	MOUNTING REQUIREMENTS					SIZE OF EQUIPMENT				UNIT WEIGHT (LBS)	ELECTRICAL			VENT	PUMBING	DATA LINE	FINISH INSTALLATION	ANCHORAGE/ DETAIL REFERENCE	REMARKS
							FLOOR	WALL	CEILING	COUNTER TOP	PORTABLE	LENGTH	DEPTH	HEIGHT	VOLT		PHASE	AMP							
001	NUVERA 144 BLACK AND WHITE COPIER	-	-	-	Y	-	-	-	-	-	-	312 +/-	30	-	-	200/240	-	50	-	-	-	-	-	50-60 Hz, DEDICATED LINE W/ CIRCUIT BREAKER, NEMA 14-50R	
002	SHRINK WRAP	-	-	-	Y	-	-	-	-	-	-	82	30	-	-	220	-	18	-	-	-	-	-	DEDICATED LINE W/ CIRCUIT BREAKER	
003	STERLING DIGI PERFECT BINDER	-	-	-	Y	-	-	-	-	-	-	55	32	-	-	220	1	-	-	-	-	-	-	50/60 Hz	
004	VERSANT 180 COLOR COPIER	-	-	-	Y	-	-	-	-	-	-	161 +/-	33	-	-	208/240	-	-	-	-	-	-	-	50/60 Hz, NEMA 6-20R	
005	NEOPOST ENVELOPE PRINTER	-	-	-	Y	-	-	-	-	-	-	96	24	-	-	110	-	-	-	-	-	-	-	-	
006	ROLLEM NUMBERING MACHING	-	-	-	Y	-	-	-	-	-	-	55	36	-	-	110	-	20	-	-	-	-	-	-	
007	COLLATER	-	-	-	Y	-	-	-	-	-	-	14'-5 3/8"	36"	-	-	240 110 110	1 - -	30 50/60 Hz 60 Hz	-	-	-	-	-	3 SEPARATE DEDICATED LINES W/ CIRCUIT BREAKERS	
008	FOLDER	-	-	-	Y	-	-	-	-	-	-	51	34	-	-	115	-	14	-	-	-	-	-	60 Hz	
009	CREASER	-	-	-	Y	-	-	-	-	-	-	51	34	-	-	-	-	-	-	-	-	-	-	-	
010	MORGANA FOLDER DOCUFOLD PRO	-	-	-	Y	-	-	-	-	-	-	55	20	-	-	220	-	30	-	-	-	-	-	-	
011	CONVEYER	-	-	-	Y	-	-	-	-	-	-	34	12	-	-	-	-	-	-	-	-	-	-	-	
012	HOLE PUNCH	-	-	-	Y	-	-	-	-	-	-	41	36	-	-	208/230	-	10	-	-	-	-	-	-	
013	COLLATER ATTACHMENT	-	-	-	Y	-	-	-	-	-	-	18	24	-	-	-	-	-	-	-	-	-	-	-	
014	PAPER CUTTER	PERFECTA	-	-	Y	-	S-201	-	-	-	-	79	65	-	-	220	3	20	-	-	-	-	-	DEDICATED LINE W/ CIRCUIT BREAKER	
015	LAMINATOR	-	-	-	Y	-	-	-	-	-	-	54	24	-	-	220	1	12	-	-	-	-	-	60 Hz, DEDICATED LINE W/ CIRCUIT BREAKER	
016	PRINTING PRESS	RYOBI	3022	-	Y	-	S-201	-	-	-	-	8'	5'	-	-	208	-	13.5	-	-	-	-	-	-	
017	CONVEYER	-	-	-	Y	-	-	-	-	-	-	44	14	-	-	-	-	-	-	-	Y	O/V	-	-	
018	EPS FEEDER	-	-	-	Y	-	-	-	-	-	-	36	14	-	-	-	-	-	-	-	-	-	-	-	
019	CIRCULATION SYSTEM	-	-	-	Y	-	-	-	-	-	-	24	24	-	-	-	-	-	-	-	-	-	-	-	
020	PRINTING PRESS CONSOLE	RYOBI 3022	-	-	Y	-	-	-	-	-	-	24	24	-	-	-	-	-	-	-	-	-	-	-	
021	EPSON 9800	-	-	-	Y	-	-	-	-	-	-	67	28	-	-	100/240	1.0-0.5	-	-	-	-	-	-	50-60 Hz	
022	MUTOH COMPUTER	-	-	-	Y	-	-	-	-	-	-	69	33	-	-	-	-	-	-	-	-	-	-	-	
023	MUTOH PRINTER	-	-	-	Y	-	-	-	-	-	-	83	48	-	-	110	-	-	-	-	-	-	-	-	
024	MUTOH CUTTER	-	-	-	Y	-	-	-	-	-	-	71	32	-	-	110	-	-	-	-	-	-	-	-	
025	CRON PLATE MAKER	-	-	-	Y	-	-	-	-	-	-	9'5"	54	-	-	2-220 1-208 2-110	1 - -	-	-	-	-	-	-	-	
026	RIP COMPUTER	-	-	-	Y	-	-	-	-	-	-	48	24	-	-	110	15	-	-	-	-	-	-	-	
027	PRINTING PRESS CONSOLE	RYOBI	-	-	Y	-	-	-	-	-	-	51	39	-	-	-	-	-	-	-	-	-	-	-	
028	PRINTING PRESS	RYOBI	524GE	-	Y	-	S-201	-	-	-	-	15'-6"	6'-6"	-	-	200 220	3	47 50	-	-	-	-	-	DEDICATED LINE W/ CIRCUIT BREAKER	
029	AIR COMPRESSOR	-	-	-	Y	-	-	-	-	-	-	-	-	-	-	110	-	10	-	-	-	-	-	-	
030	FORKLIFT CHARGER	-	-	-	Y	-	-	-	-	-	-	9'8"	45	-	-	220	-	-	-	-	-	-	-	FUSE BOX	
031	REFRIGERATOR	-	-	-	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
032	STAPLER	-	-	-	Y	-	-	-	-	-	-	22	35	-	-	-	-	-	-	-	-	-	-	-	
033	SMALL STAPLER	-	-	-	Y	-	-	-	-	-	-	48	24	-	-	120	-	6.8	-	-	-	-	-	-	
034	D95 COLOR COPIER	-	-	-	Y	-	-	-	-	-	-	84	32	-	-	220 115	-	15 OR 20	-	-	-	-	-	TOP LINE = ENGINE, NEMA 6-15R BOTTOM LINE = FINISHER, NEMA 5-15R OR 5-20R	
035	SPIRAL BIND	-	-	-	Y	-	-	-	-	-	-	-	-	-	-	110	-	4	-	-	-	-	-	-	
036	COMB BIND	-	-	-	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
037	MICROWAVE	-	-	-	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
038	MICROWAVE	-	-	-	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
039	CARMEN'S COMPUTER	-	-	-	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
040	GLORIA'S COMPUTER	-	-	-	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
041	DEBBIE'S COMPUTER	-	-	-	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
042	ANNA'S COMPUTER	-	-	-	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
043	ANDY'S COMPUTER	-	-	-	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
044	STRAPPING	-	-	-	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
045	FIERY COMPUTER	-	-	-	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
046	NEOPOST COMPUTER	-	-	-	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
047	POSTER WORK	-	-	-	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
048	STORAGE RACK	-	-	-	Y	-	S-201	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

REMARKS

1. CONDUCT PRECONSTRUCTION MEETING WITH DISTRICT REPRESENTATIVES TO VERIFY POWER REQUIREMENTS AND LAYOUT PRIOR TO CONSTRUCTION.
2. EQUIPMENT OWNER FURNISHED, OWNER INSTALLED
3. ANCHORAGE PER S-201 CONTRACTOR FURNISHED, CONTRACTOR INSTALLED



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SHEET TITLE

EQUIPMENT
SCHEDULE

DRAWN BY: MH/QP

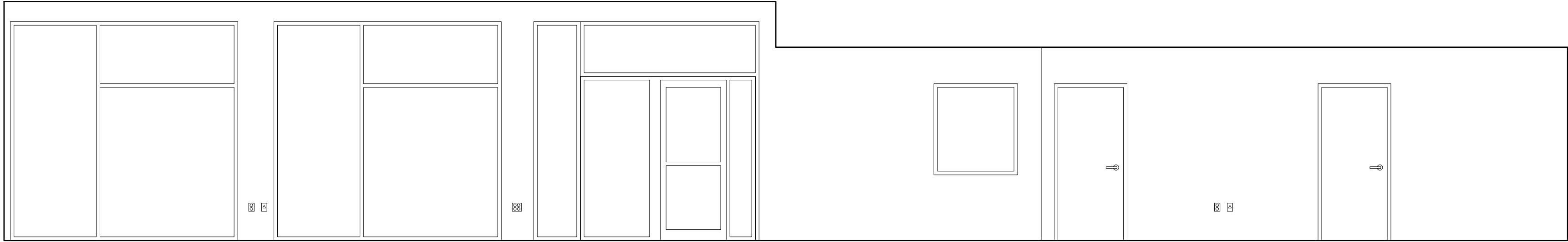
JOB NUMBER: 18116.03

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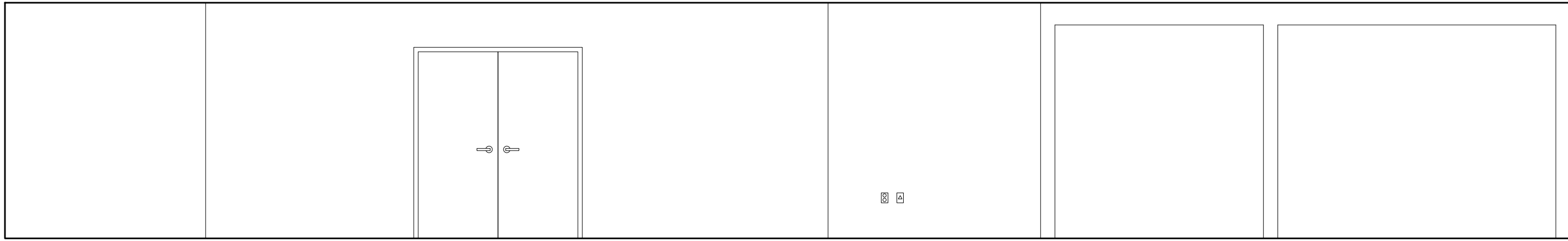
A-502

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

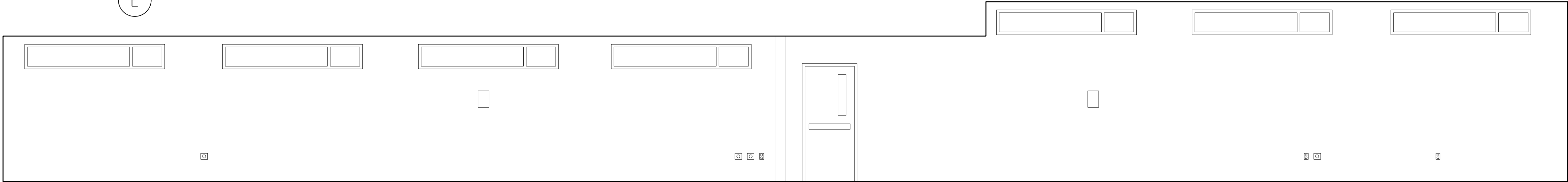
PLOT BY: HARTMAN
 PLOT DATE: Nov 12, 2018 - 6:49PM
 DRAWING NAME: H:\2018\B1603 CHC District Print Shop T1.CDS THROUGH CA Drawings\Plot Files\B16.03-A-601.dwg



N



E



S



W

ROOM 101 - PRINT SHOP

SCALE: 1/4" = 1'-0"

1

KEYNOTES

06.01 PLYWOOD SHEATHING

LEGEND

- DUPLEX OUTLET, SEE ELECTRICAL DRAWINGS
- QUAD OUTLET, SEE ELECTRICAL DRAWINGS
- DATA OUTLET, SEE ELECTRICAL DRAWINGS
- 220V OUTLET, SEE ELECTRICAL DRAWINGS
- DISCONNECT

GENERAL NOTES

- SEE FINISH SCHEDULE/A-621 FOR ADDITIONAL INFORMATION



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SHEET TITLE

INTERIOR
ELEVATIONS

DRAWN BY: MH/QP

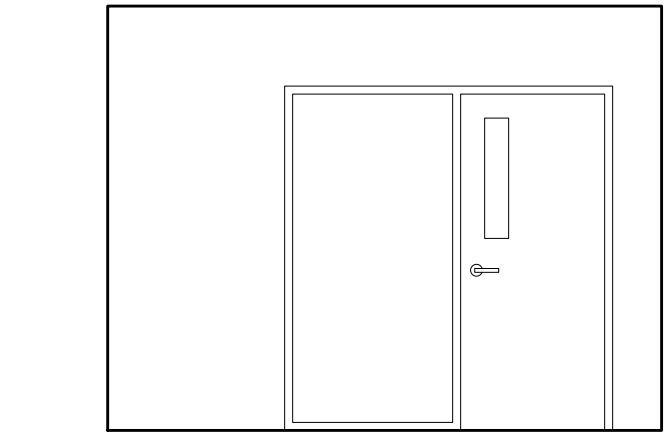
JOB NUMBER: 18116.03

SHEET NO.

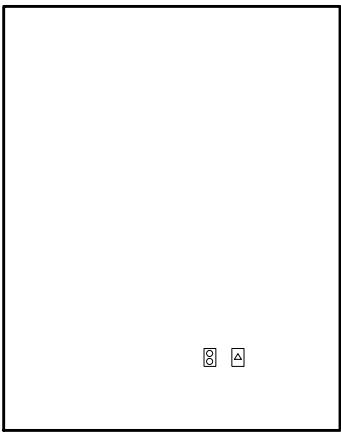
A-601

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

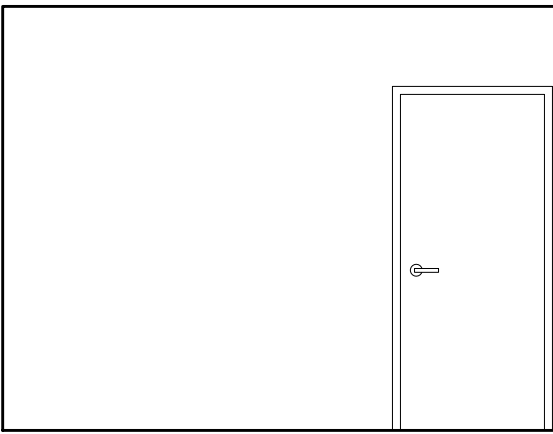
PLOT BY: HARTMAN
 PLOT DATE: Nov 12, 2018 - 6:54AM
 DRAWING NAME: I:\2018\B1603 CHC District Print Shop T1-CDS THROUGH CA Drawings\BLOT Files\B16.03-A-602.DWG



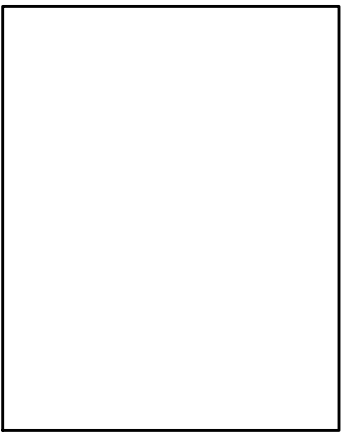
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E



S

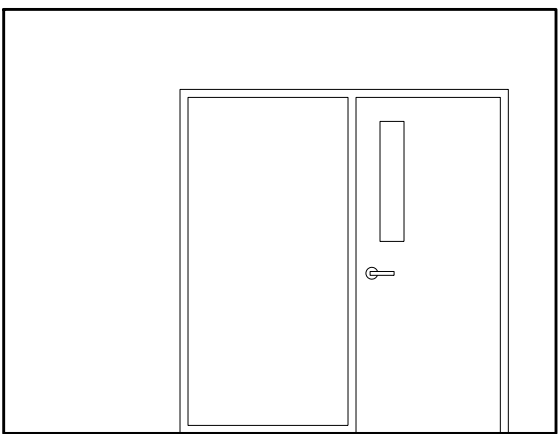


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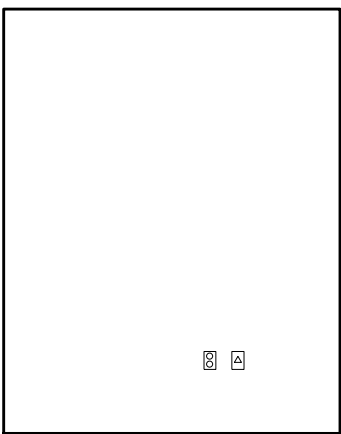
ROOM 102 - OFFICE

SCALE: 1/4" = 1'-0"

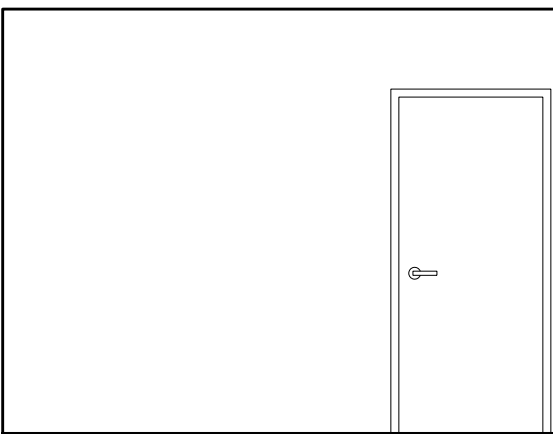
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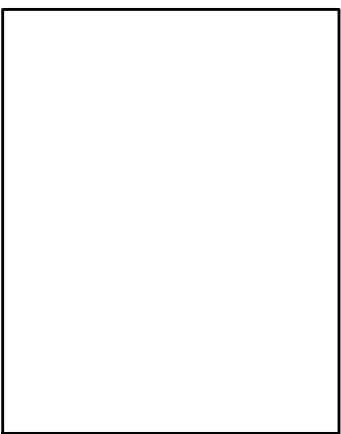
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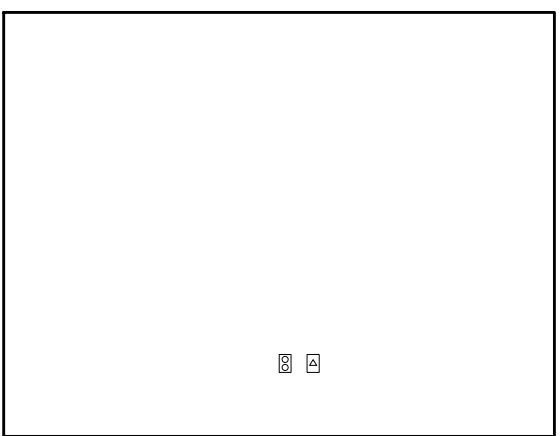


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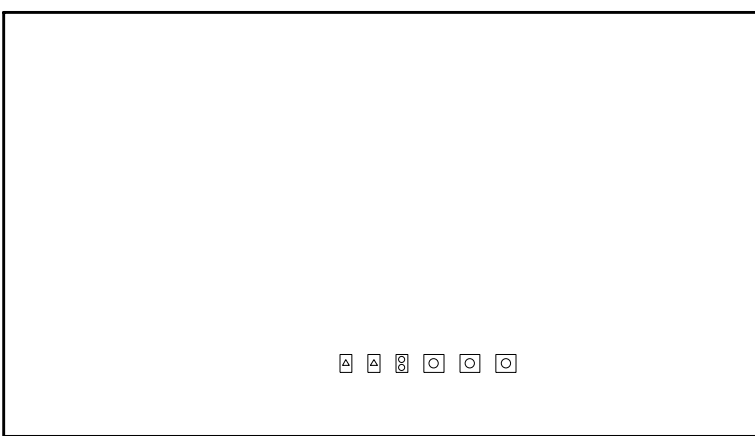
ROOM 103 - OFFICE

SCALE: 1/4" = 1'-0"

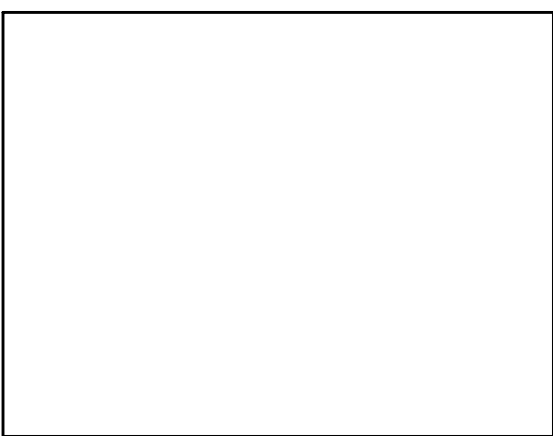
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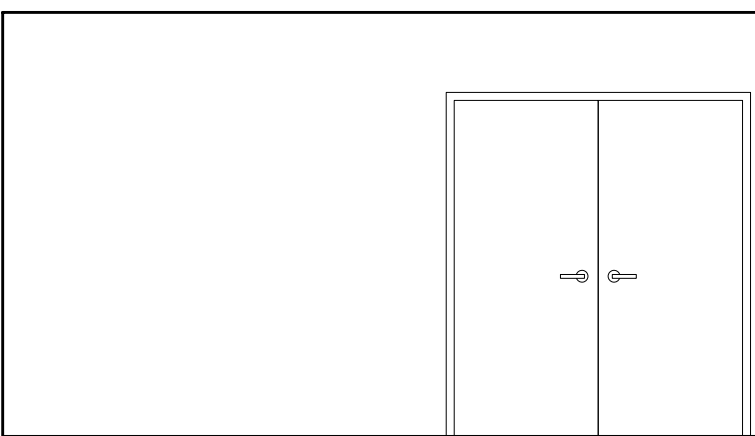
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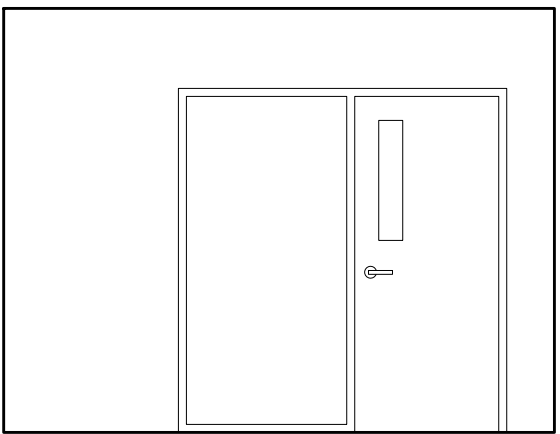


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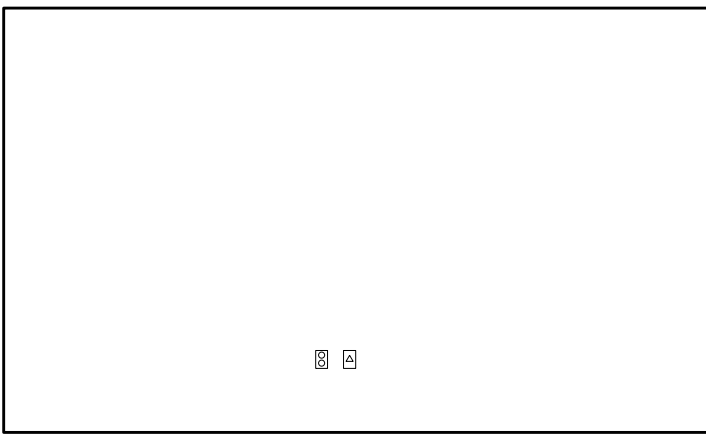
ROOM 104 - CRON PLATE

SCALE: 1/4" = 1'-0"

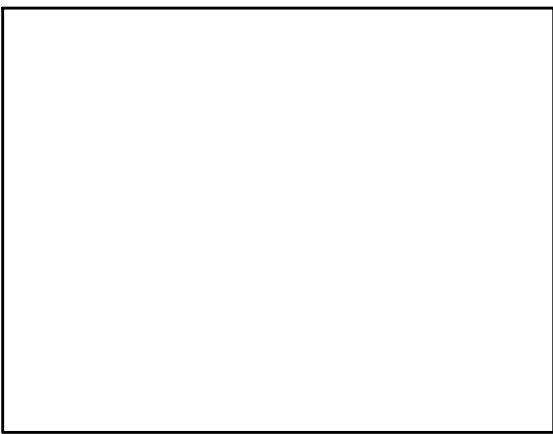
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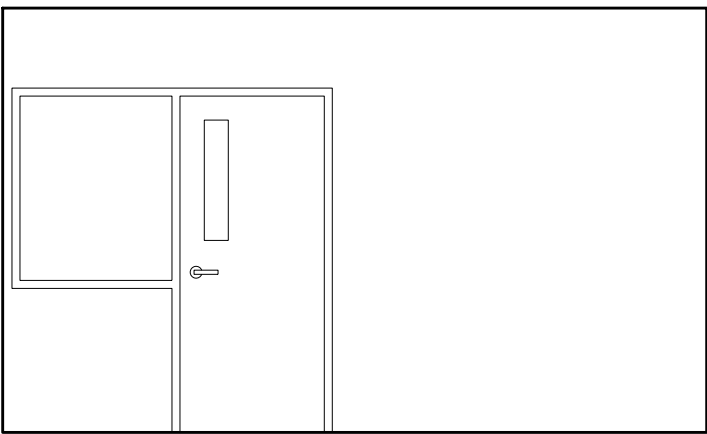
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E



S

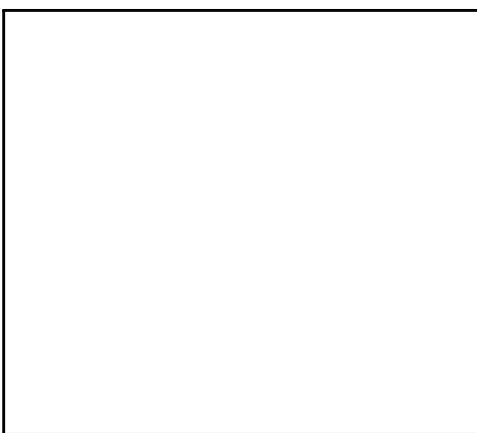


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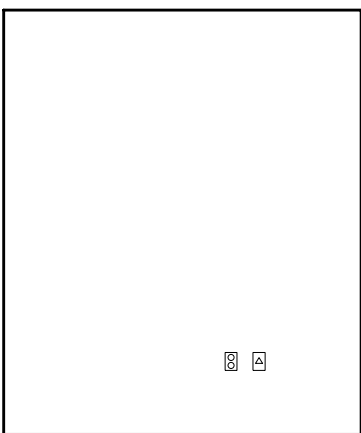
ROOM 105 - SUPER. OFFICE

SCALE: 1/4" = 1'-0"

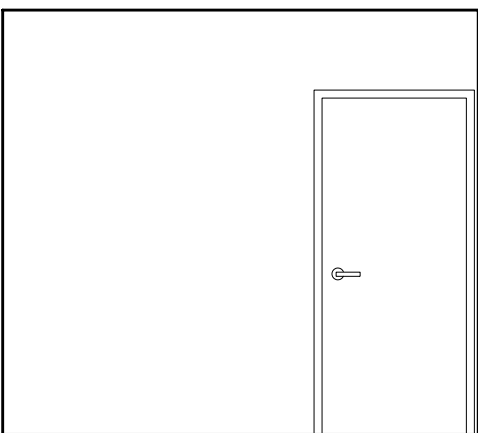
4



N



E



S



W

ROOM 113 - OFFICE

SCALE: 1/4" = 1'-0"

5

KEYNOTES

0X.XX XXX

LEGEND

-  DUPLEX OUTLET, SEE ELECTRICAL DRAWINGS
-  QUAD OUTLET, SEE ELECTRICAL DRAWINGS
-  DATA OUTLET, SEE ELECTRICAL DRAWINGS
-  220V OUTLET, SEE ELECTRICAL DRAWINGS
-  DISCONNECT SWITCH, SEE ELECTRICAL DRAWINGS

GENERAL NOTES

- SEE FINISH SCHEDULE/A-621 FOR ADDITIONAL INFORMATION.



196
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SHEET TITLE

INTERIOR
ELEVATIONS

DRAWN BY: MH/QP

JOB NUMBER: 18116.03

SHEET NO.

A-602

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

DRAWING NAME: I:\2018\B1805 CHC District Print Shop T1.CDS THROUGH CADRAWINGS\DOT FILES\B1805-A-621.DWG
PLOT DATE: Nov 12, 2018 - 7:58AM
PLOT BY: HARTMAN

FINISH SCHEDULE																
LOCATION		FLOOR	BASE	WALLS		TRIM & ACCENT		MILLWORK			CEILING			NOTES		
ROOM #	ROOM NAME	FINISHES	FINISH	FINISHES		INTERIOR DOORS & TRIM	EXTERIOR DOORS & TRIM	C-TOPS		CABINETRY		MATERIAL	FINISH	SOFFIT/B.H.		FINISH NOTES (SEE BELOW)
					OTHER			FINISH	WALL	BASE	MATERIAL			FINISH	MATERIAL	
101	PRINT SHOP	CS-1	RB-1	GYP. BD.	PT-1	PT-2	PT-3	-	-	-	CT-1	-	-	-		
102	OFFICE	CT-1	RB-1	GYP. BD.	PT-1	PT-2	PT-3	-	-	-	CT-2	-	-	-		
103	OFFICE	CT-1	RB-1	GYP. BD.	PT-1	PT-2	PT-3	-	-	-	CT-2	-	-	-		
104	CRON PLATE	CS-1	RB-1	GYP. BD.	PT-1	PT-2	PT-3	-	-	-	CT-2	-	-	-		
105	SUPERVISOR'S OFFICE	CT-1	RB-1	GYP. BD.	PT-1	PT-2	PT-3	-	-	-	CT-2	-	-	-		
107	BREAK AREA	CS-1	RB-1	GYP. BD.	PT-1	PT-2	PT-3	(E)	(E)	(E)	CT-1	-	-	-		
108	RESTROOM	(E)	(E)	(E)	PT-1	PT-2	PT-3	-	-	-	(E)	PT-4	-	-		
109	ELECTRICAL	(E)	(E)	GYP. BD.	PT-1	PT-2	PT-3	-	-	-	(E)	PT-4	-	-		
110	CUSTODIAL	(E)	(E)	(E)	PT-1	PT-2	PT-3	-	-	-	(E)	PT-4	-	-		
111	MENS RESTROOM	(E)	(E)	(E)	PT-1	PT-2	PT-3	-	-	-	(E)	PT-4	-	-		
112	WOMENS RESTROOM	(E)	(E)	(E)	PT-1	PT-2	PT-3	-	-	-	(E)	PT-4	-	-		
113	OFFICE	CT-1	RB-1	GYP. BD.	PT-1	PT-2	PT-3	-	-	-	CT-2	PT-4	-	-		

FINISH KEY					
ROOM MATERIAL CODE	DESCRIPTION	MANUFACTURER	PRODUCT STYLE	PRODUCT COLOR	SPEC SECTION
FLOORING					
CT-1	CARPET TILE	SHAW	TBD	TBD	09 68 13
CS-1	CONCRETE SEALER	SCOFIELD	TBD	CLEAR, EGGSHELL FINISH	07 19 00
BASE					
RB-1	4" RUBBER BASE	BURKE	COVED, TOPSET	TBD	09 65 30
PAINT					
PT-1	GENERAL WALL COLOR U.N.O.	SHERWIN WILLIAMS	EGGSHELL	TBD	09 90 00
PT-2	INTERIOR DOORS & TRIM	SHERWIN WILLIAMS	SEMI-GLOSS	TBD	09 90 00
PT-3	EXTERIOR DOORS & TRIM	SHERWIN WILLIAMS	SEMI-GLOSS	TBD	09 90 00
PT-4	GENERAL CEILING COLOR U.N.O.	SHERWIN WILLIAMS	EGGSHELL	TBD	09 90 00
CEILINGS					
CT-1	24"x24" & 24"x48" CEILING TILE, UN-RATED CEILING SYSTEM. SUSPENDED LAY IN ACOUSTICAL TILES.	ARMSTRONG	OPTIMA VECTOR	WHITE	09 51 10
CT-2	24"x48" CEILING TILE, UN-RATED CEILING SYSTEM. SUSPENDED LAY IN ACOUSTICAL TILES.	ARMSTRONG	ULTIMA VECTOR	WHITE	09 51 10

GENERAL NOTES

- SEE SECTION 09 29 00 FOR GYPSUM BOARD
- (E) CERAMIC TILE IN RESTROOMS TO REMAIN U.N.O.
- ANCHORAGE PER S-201 CONTRACTOR FURNISHED, CONTRACTOR INSTALLED



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SHEET TITLE

FINISH SCHEDULE

DRAWN BY: MH/QP
JOB NUMBER: 18116.03

SHEET NO.

A-621

DATE: NOVEMBER 2, 2018
SHEET ____ OF ____

PLOT BY: HARTMAN
 PLOT DATE: Nov 12, 2018 - 8:04PM
 DRAWING NAME: IN:\2018\B1603 CHC District Print Shop T1.CDS THROUGH CA Drawings\Plot Files\B16.03-A-801.DWG

DOOR & FRAME SCHEDULE																
	MARK	ASSEMBLY NON-RATED IS TYPICAL	SIZE		DOOR				FRAME			DETAILS			HARDWARE GROUP	NOTES
					TYPE	MATERIAL	FACING & FINISH	LOUVER HEIGHT	TYPE	MATERIAL	FINISH	HEAD	JAMB	THRESHOLD		
LOCATION	101	-	3'-0"	7'-6"	1	SF	TBD	-	-	-	-	-	-	-	-	
	102	-	3'-0"	7'-0"	1	SC	TBD	-	-	-	-	-	-	-	-	
	103	-	3'-0"	7'-0"	1	SC	TBD	-	-	-	-	-	-	-	-	
	104	-	6'-0"	7'-0"	1	SC	TBD	-	-	-	-	-	-	-	-	
	105	-	3'-0"	7'-0"	1	SC	TBD	-	-	-	-	-	-	-	-	
	107	-	3'-0"	7'-0"	1	HM	TBD	-	-	-	-	-	-	-	-	
	108	-	3'-0"	7'-0"	(E)	(E)	(E)	-	-	-	-	-	-	-	-	
	109	-	3'-0"	7'-0"	(E)	(E)	(E)	-	-	-	-	-	-	-	-	
	110	-	3'-0"	7'-0"	(E)	(E)	(E)	-	-	-	-	-	-	-	-	
	111	-	3'-0"	7'-0"	(E)	(E)	(E)	(E)	-	-	-	-	-	-	-	
	112	-	3'-0"	7'-0"	(E)	(E)	(E)	(E)	-	-	-	-	-	-	-	
	113	-	3'-0"	7'-0"	1	SC	TBD	-	-	-	-	-	-	-	-	

GENERAL NOTES

1. TYP. MEANS TYPICAL
2. DOOR AND FRAME NUMBERS ON SCHEDULE ARE ROOM NUMBER INTO WHICH THE DOOR SWINGS FOLLOWED BY DOOR MARK (I.E. 201A)

DOORS ARE TYPICALLY ASSIGNED AS FOLLOWS: THE DOOR IS ASSIGNED TO THE ROOM IT SWINGS INTO. CASED OR GLAZED OPENINGS ARE ASSIGNED TO THE SMALLER ROOM. IF THE DOOR SWINGS INTO AN UNASSIGNED AREA IT WILL BE ASSIGNED TO THE ROOM IT SWINGS FROM. IF THE DOOR SWINGS IN BOTH DIRECTIONS IT WILL BE ASSIGNED TO THE SMALLER ROOM.

DOOR OPENING LOCATIONS: IMMEDIATELY (5") ADJACENT TO A FLANKING WALL, UON. AT THE CENTERLINE OF THE ROOM. CENTERED ON A GRID LINE. DOOR OPENINGS IN OTHER LOCATIONS LOCATED BY DIMENSION.
3. 3'-0" IS TYPICAL WIDTH OF DOOR OPENING
 7'-0" IS TYPICAL HEIGHT OF DOOR OPENING
 1 3/4" IS TYPICAL THICKNESS OF DOOR
4. DOOR CONSTRUCTION AND MATERIAL:
 SC - SOLID CORE WOOD
 STL - STEEL
 SL - WOOD SLAB
 AL - ALUMINUM FRAME WITH GLASS OR SOLID PANEL
 SF - STOREFRONT
5. DOOR FACING AND FINISH:
 TYPICAL - PAINT GRADE HARDWOOD, PAINTED
 STL - STEEL, PAINTED
 PL - PLASTIC LAMINATE
 CV - STAIN GRADE WOOD VENEER, CLEAR VARNISH
 V - VINYL
6. FRAME MATERIAL
 STL - STEEL
 AL - ALUMINUM
 HM - HOLLOW METAL
7. FRAME FINISH
 P - PAINTED
 ANOD - ANODIZING
8. GLASS: SEE SPECIFICATIONS 08800
 A. DOORS: AS NOTED
9. DETAILS ARE NUMBERED CONSECUTIVELY PER SHEET
10. SEE SPEC SECTION 08 71 00 FOR LISTING OF HARDWARE
11. DOOR SIGNAGE - SEE SECTION 10 24 00

DOOR NOTES:

DOOR OPENING FORCE - EFFORT OF OPERATION (CBC 1008.1.3 & 1133B.2.5)

- 5 POUNDS FOR INTERIOR & EXTERIOR DOORS
- 15 POUNDS FOR FIRE DOORS.

DOOR OPERATING DEVICES SHALL BE INSTALLED 30" MINIMUM/44" MAXIMUM ABOVE THE FINISH FLOOR. (CBC 1133B.2.5.2)

EGRESS DOORS SHALL BE READILY OPERABLE FROM THE EGRESS SIDE WITHOUT THE USE OF A KEY OR SPECIAL KNOWLEDGE OR EFFORT. (CBC1008.1.9)

DOOR OPERATING DEVICES SHALL NOT REQUIRE TIGHT GRASPING, TIGHT PINCHING OR TWISTING OF THE WRIST TO OPERATE. (CBC 1008.9.1)

THE UNLATCHING OF ANY DOOR OR LEAF SHALL NOT REQUIRE MORE THAN ONE OPERATION. (CBC 1008.1.9.5).

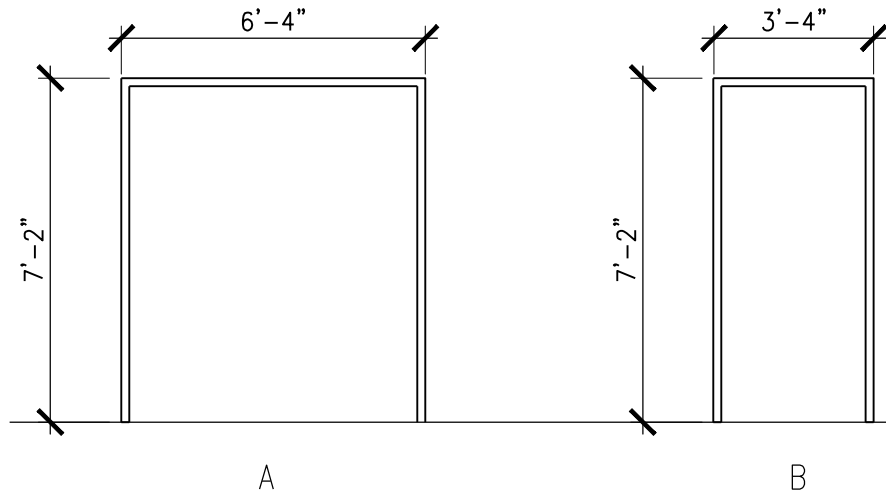
NUMBERED NOTES

- 1
- xxx

DOOR TYPES



FRAME TYPES



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SHEET TITLE

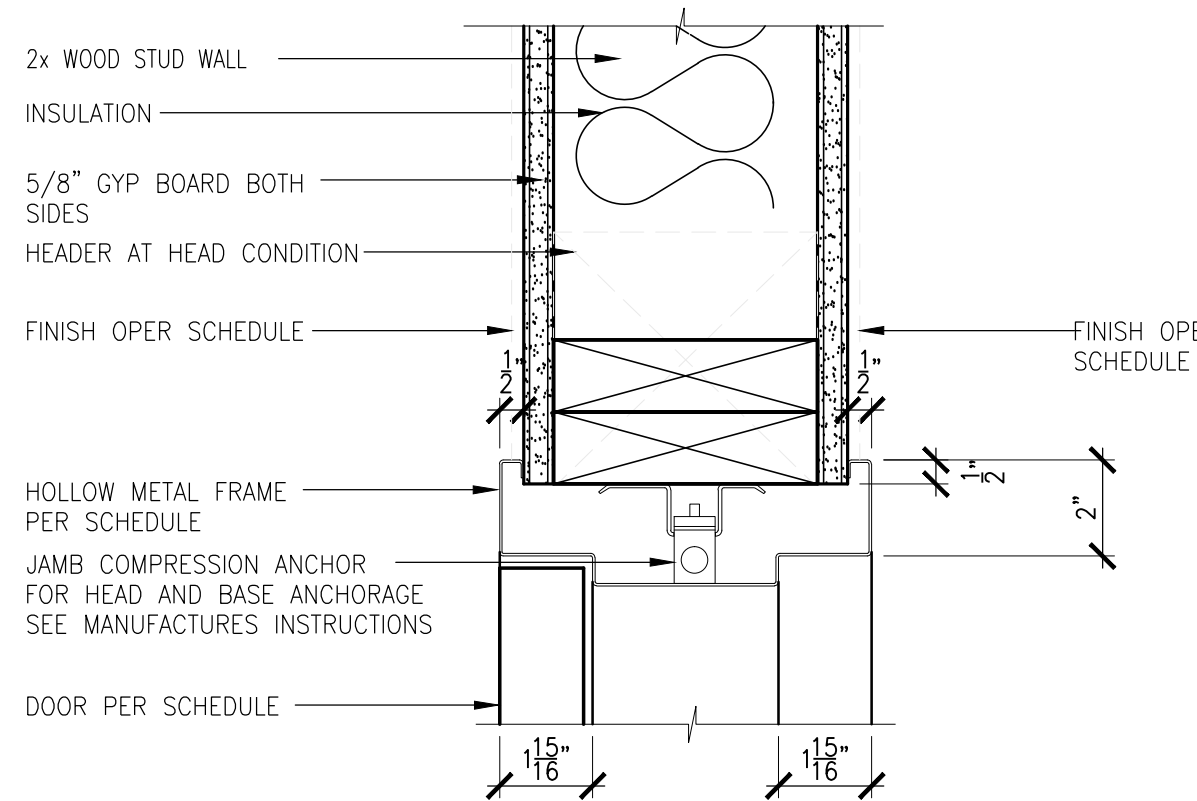
DOOR SCHEDULE

DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

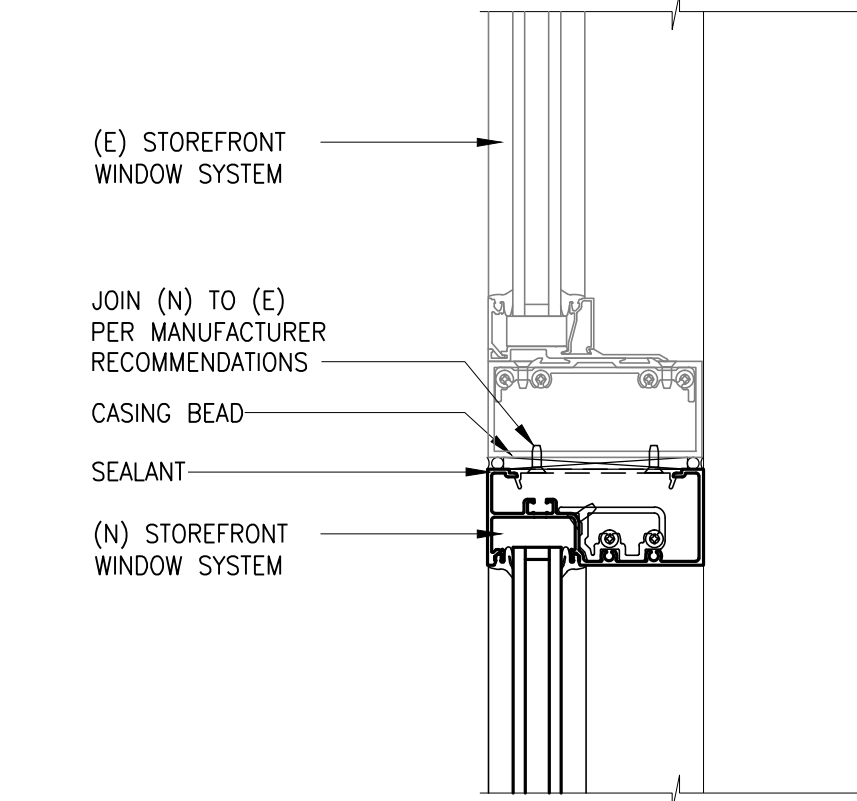
A-801

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____



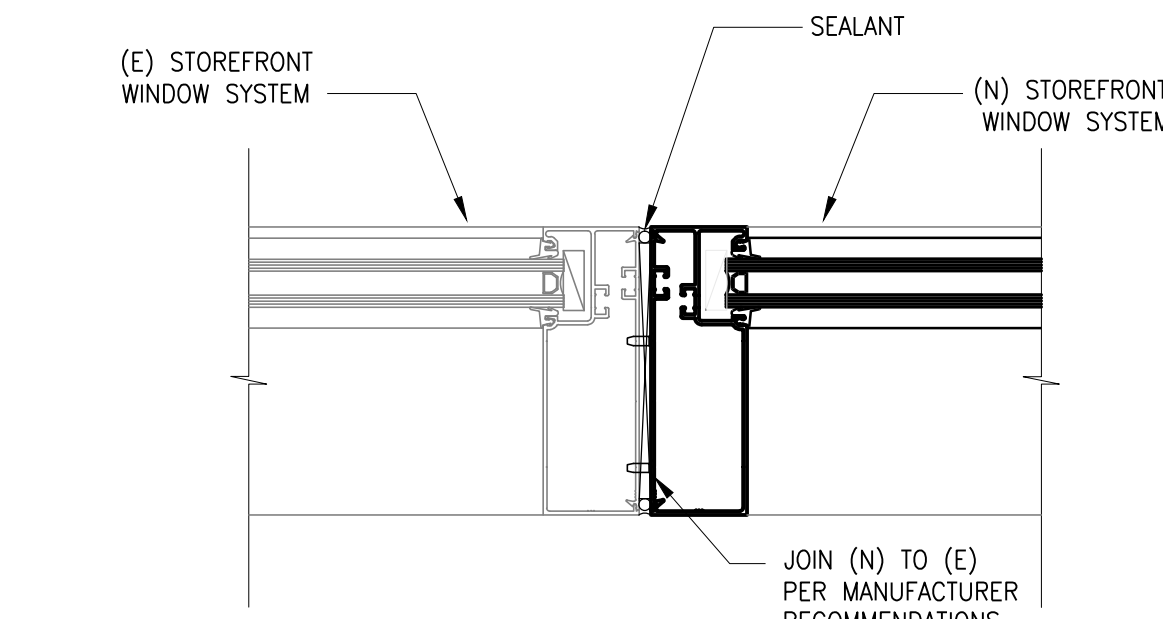
2x6 INTERIOR DOOR JAMB (HEAD SIM.)

SCALE: 3" = 1'-0"



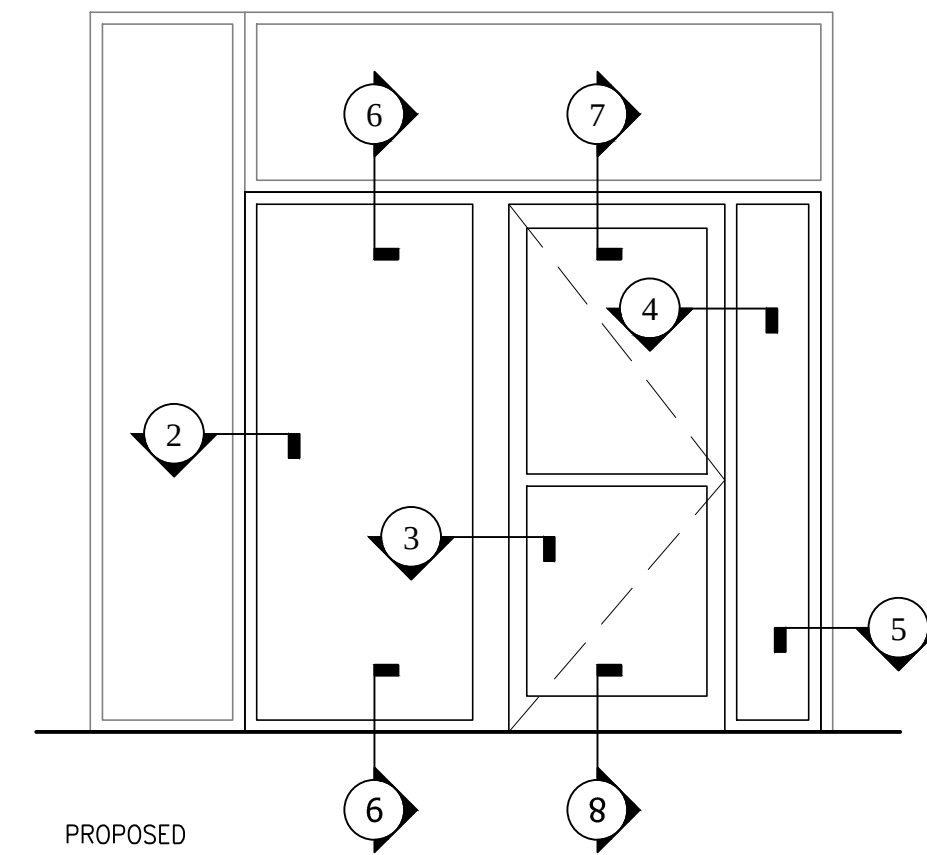
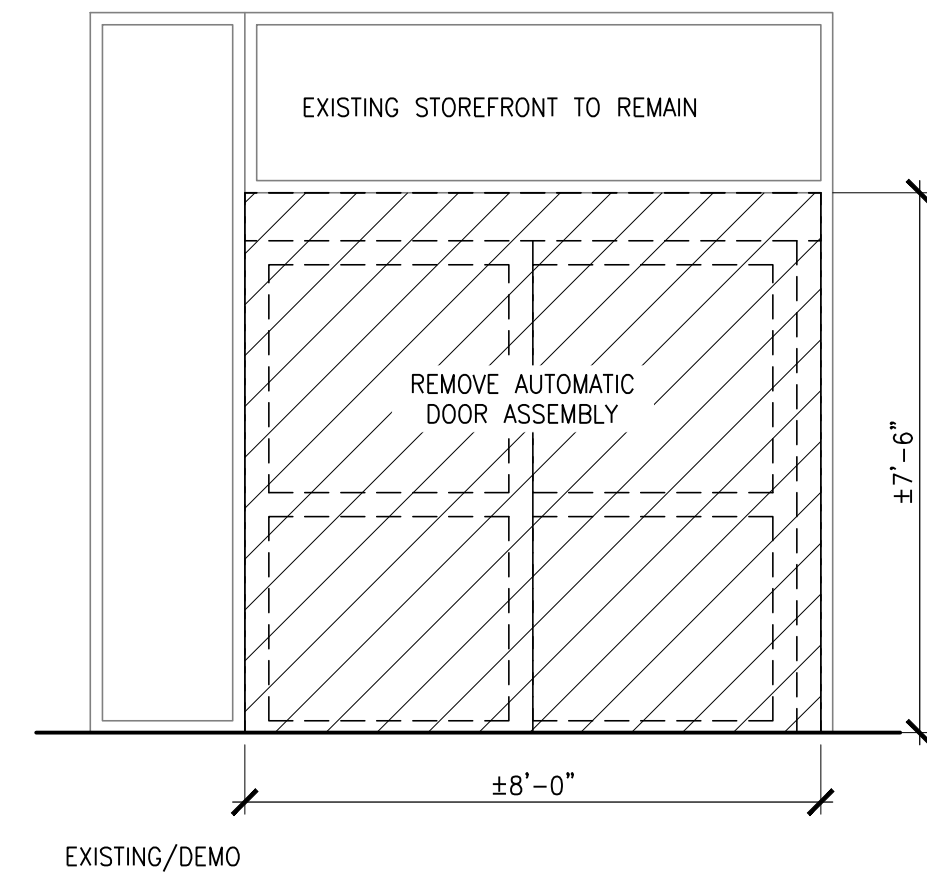
(N) TO (E) STOREFRONT TRANSOM (WINDOW)

SCALE: 3" = 1'-0"



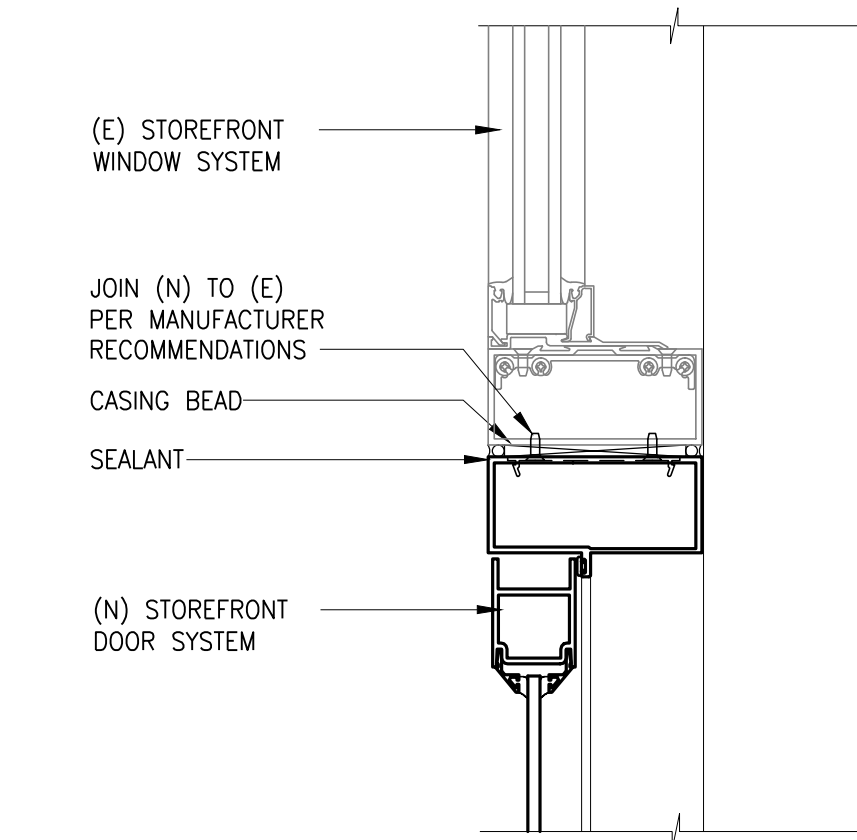
(N) TO (E) STOREFRONT FRAME

SCALE: 3" = 1'-0"



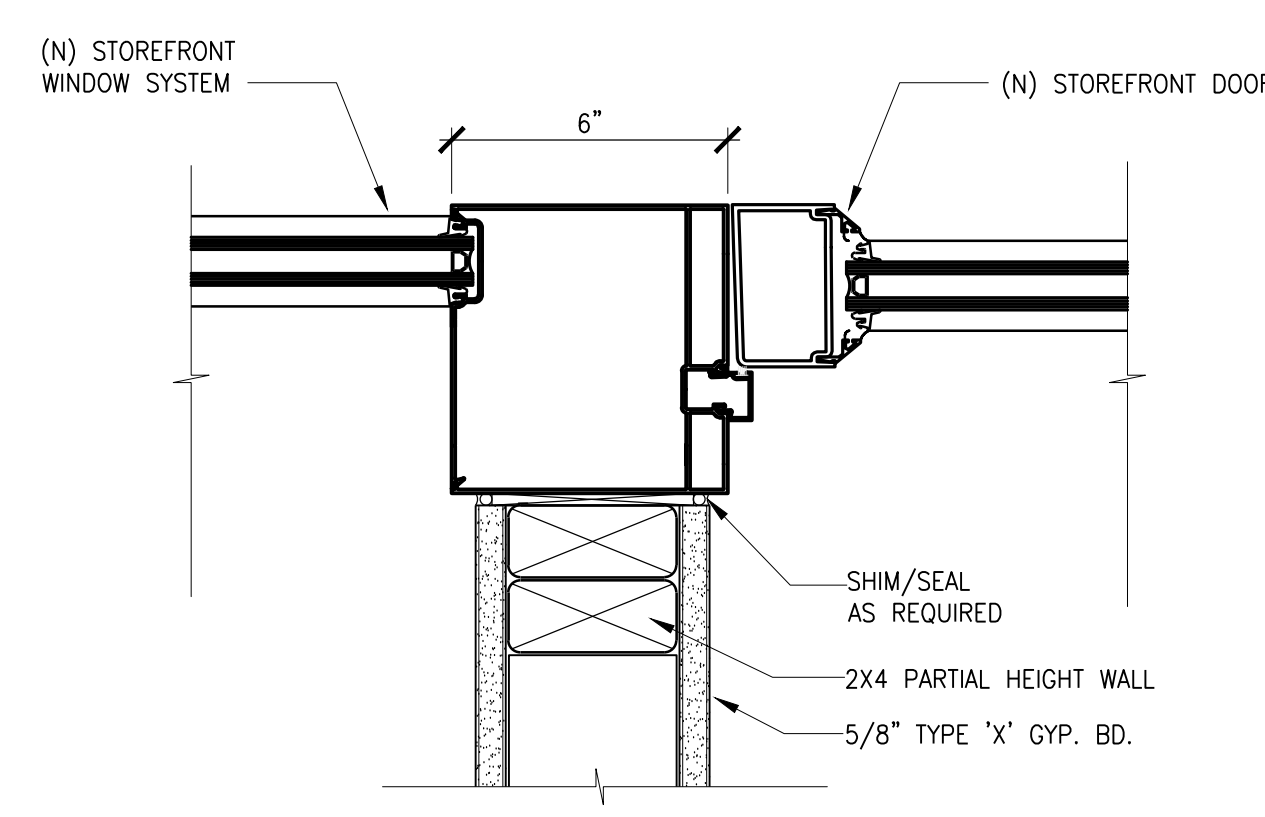
NEW ENTRY DOOR

SCALE: 3/8" = 1'-0"



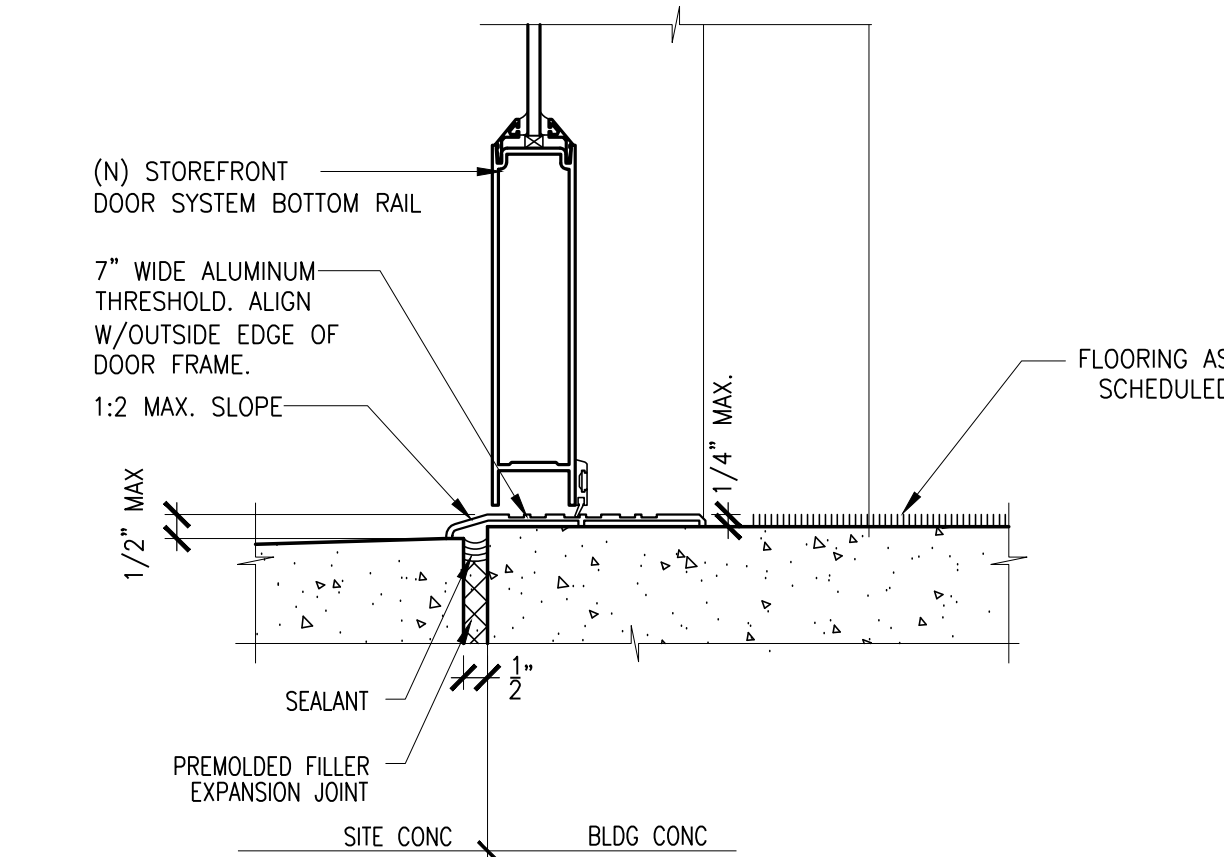
(N) TO (E) STOREFRONT TRANSOM (DOOR)

SCALE: 3" = 1'-0"



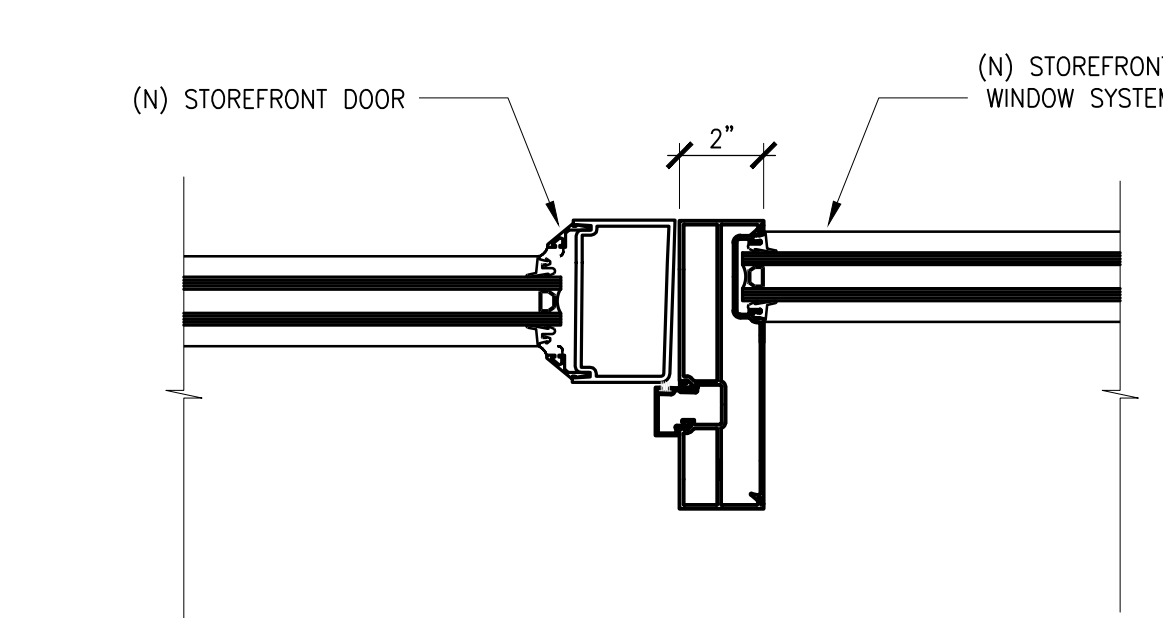
(N) STOREFRONT COLUMN @ DOOR

SCALE: 3" = 1'-0"



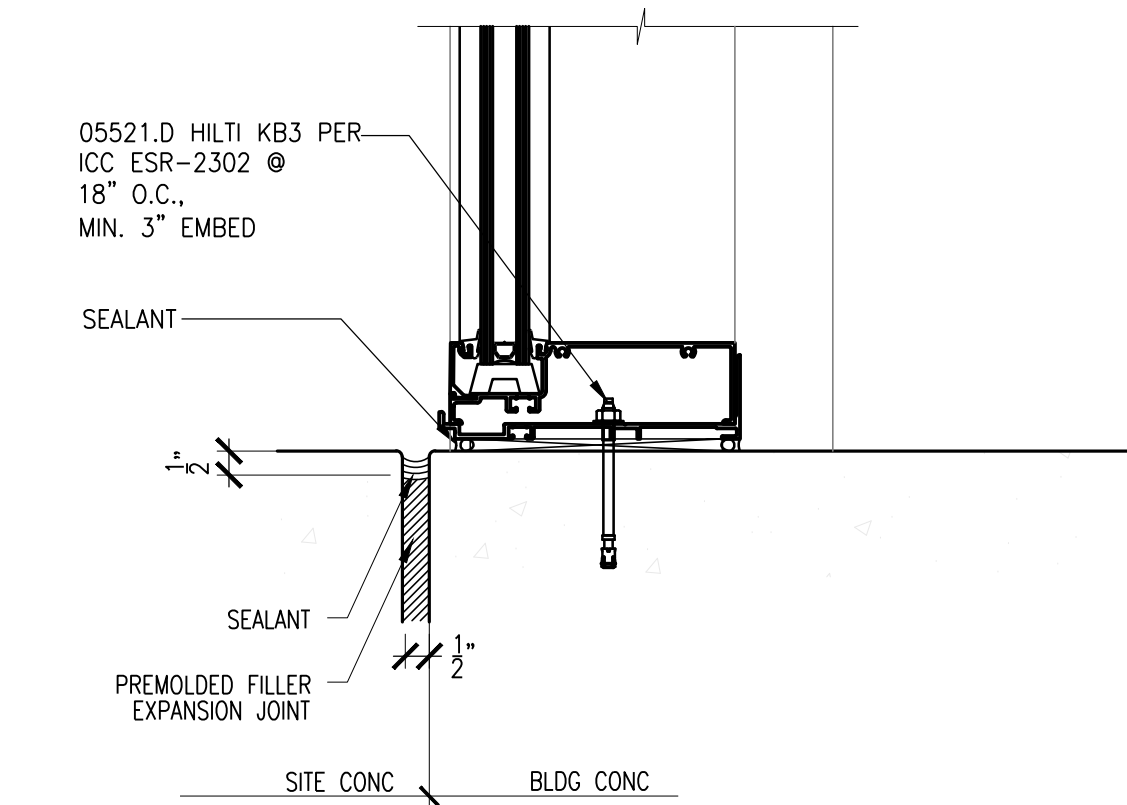
(N) STOREFRONT BOTTOM RAIL (DOOR)

SCALE: 3" = 1'-0"



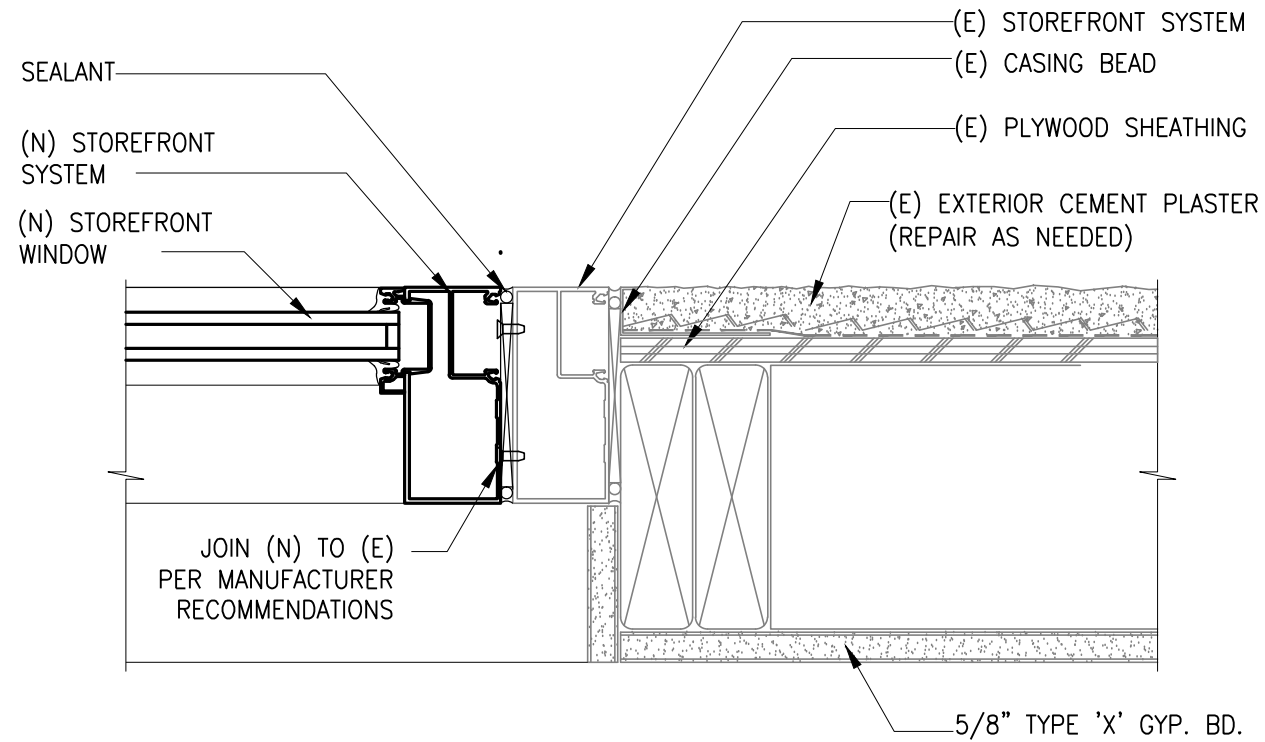
(N) STOREFRONT DOOR JAMB

SCALE: 3" = 1'-0"



(N) STOREFRONT BOTTOM RAIL (WINDOW)

SCALE: 3" = 1'-0"



(N) TO (E) STOREFRONT WINDOW JAMB

SCALE: 3" = 1'-0"

PMSM
ARCHITECTS

19.6
ARCHITECTS

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SHEET TITLE

DOOR DETAILS

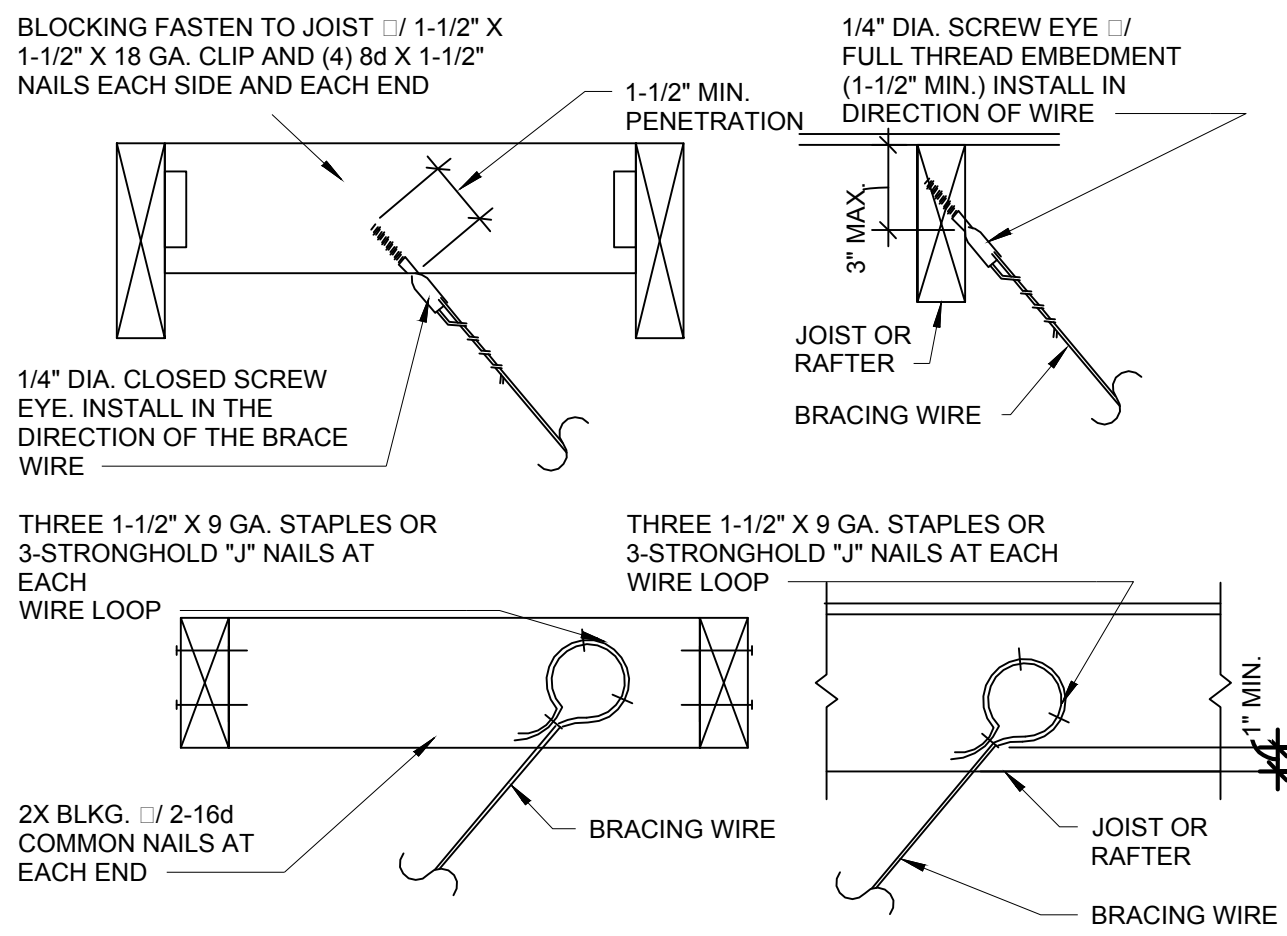
DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

A-811

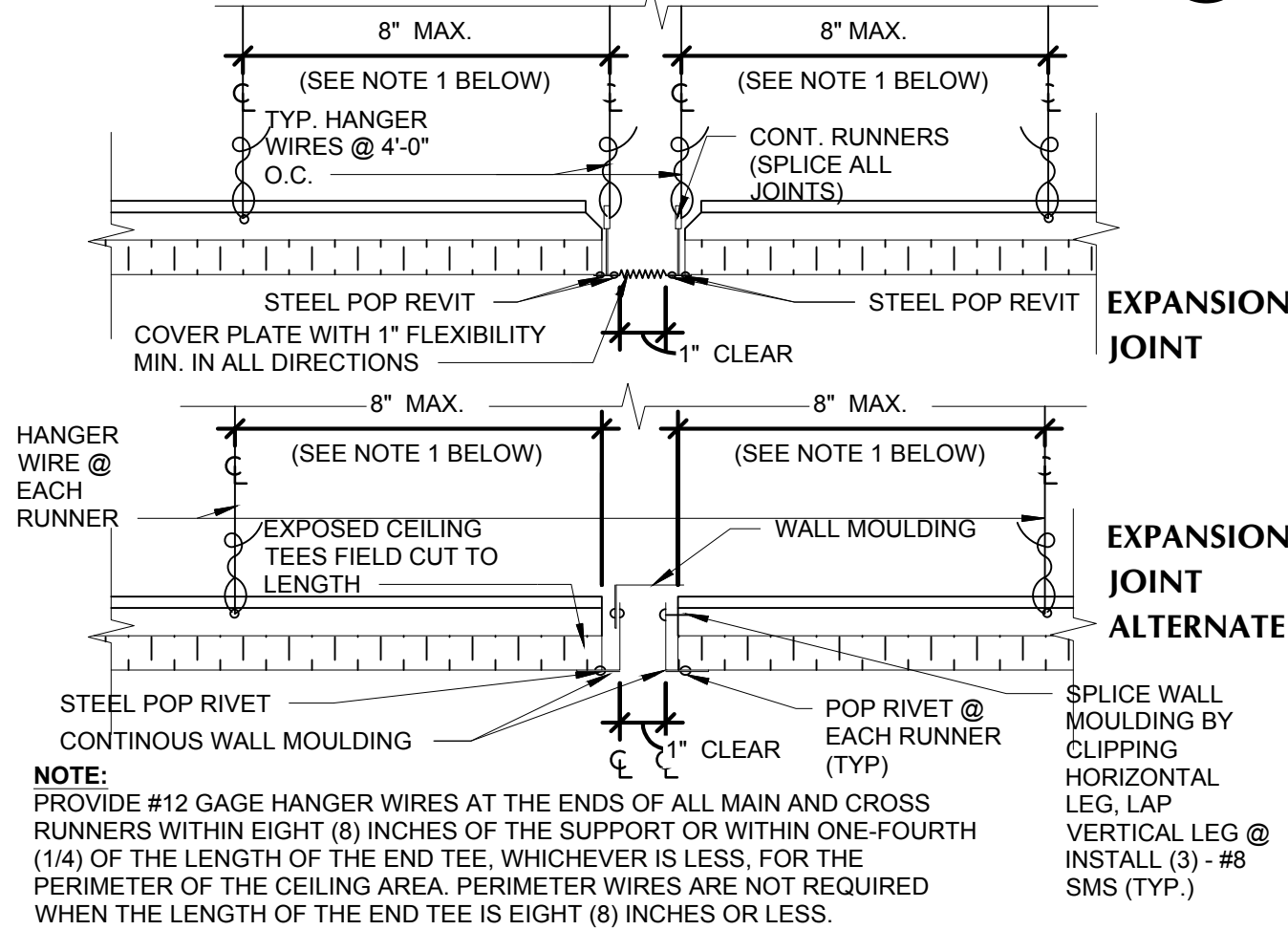
DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

DRAWING NAME: IN-2018-181603 CHC District Print Shop T1-CDS THROUGH CA Drawings)DOT FILES 1816.03-A-901.DWG
PLOT DATE: Nov 12, 2018 - 8:11AM
PLOT BY: HARTMAN



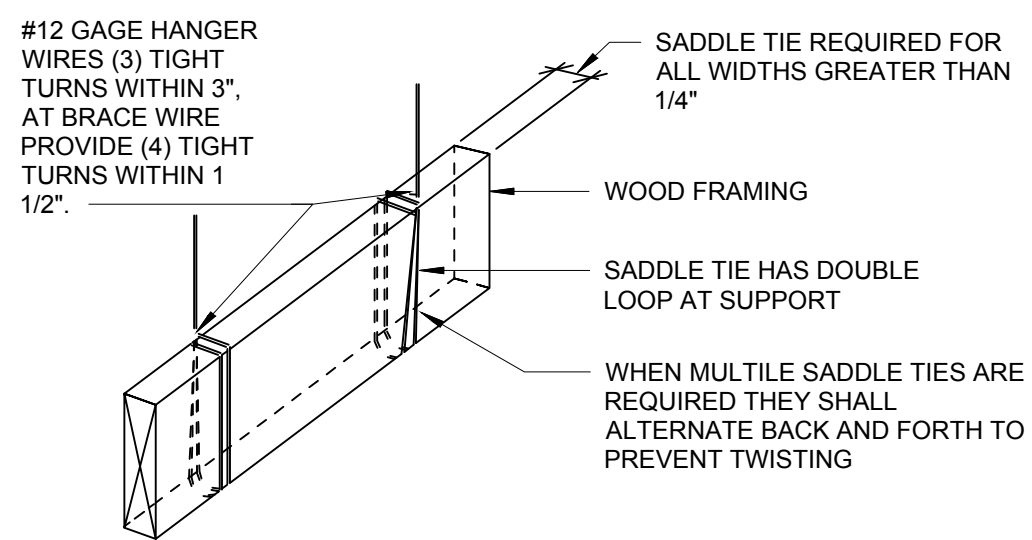
BRACE WIRE AT SAWN TIMBER

SCALE: 1-1/2" = 1'-0"



EXPANSION JOINT AT INTERSECTIONS

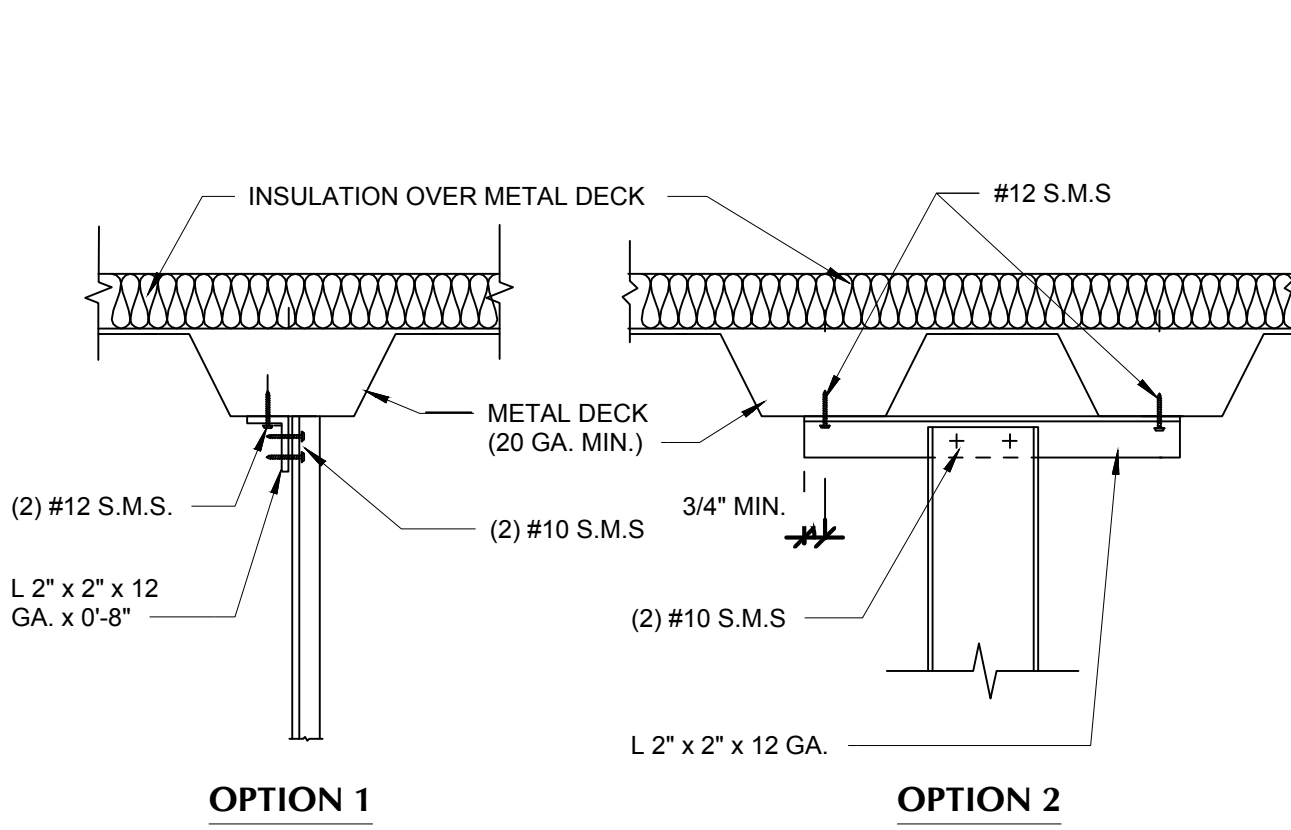
SCALE: 3" = 1'-0"



TYPICAL SADDLE TIE

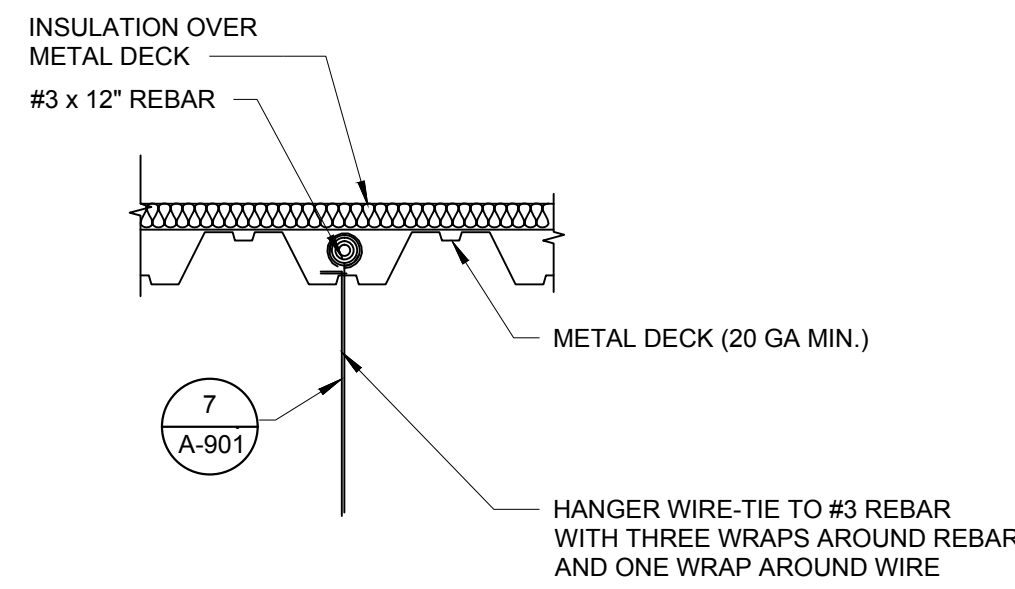
SCALE: 1-1/2" = 1'-0"

NOTE:
HANGER WIRE CONDITION SHOWN. BRACE
WIRE CONDITION SIMILAR



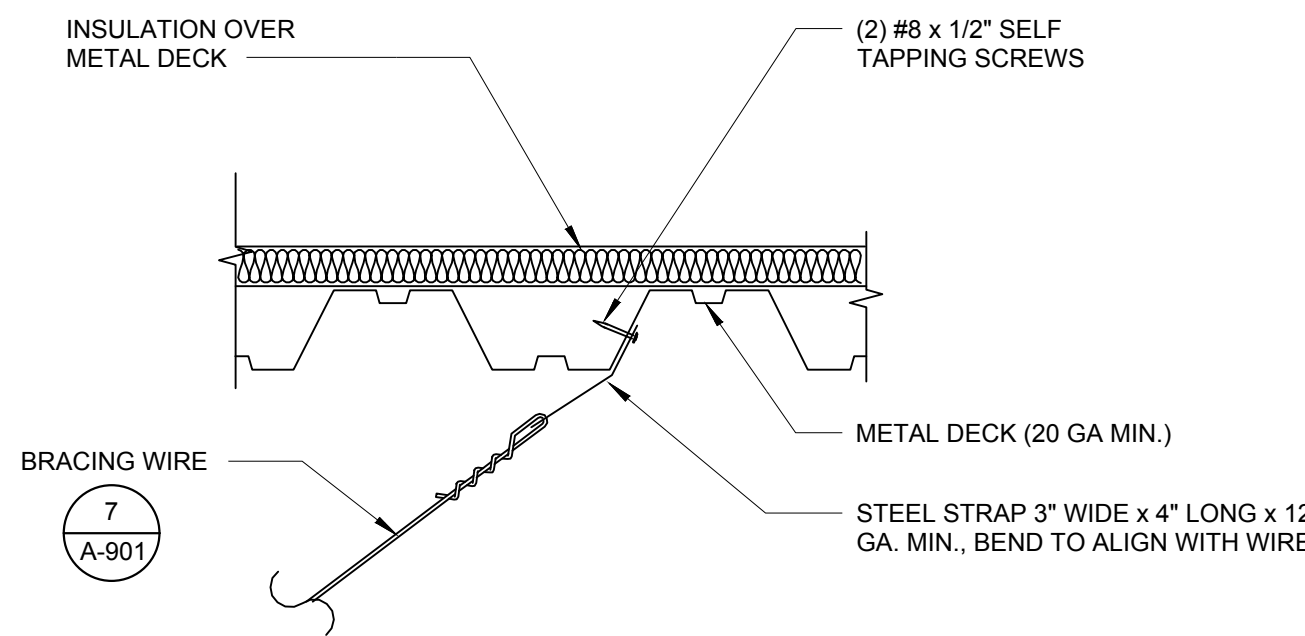
CHANNEL STRUT TO METAL DECK

SCALE: 1-1/2" = 1'-0"



HANGER WIRE TO METAL DECK

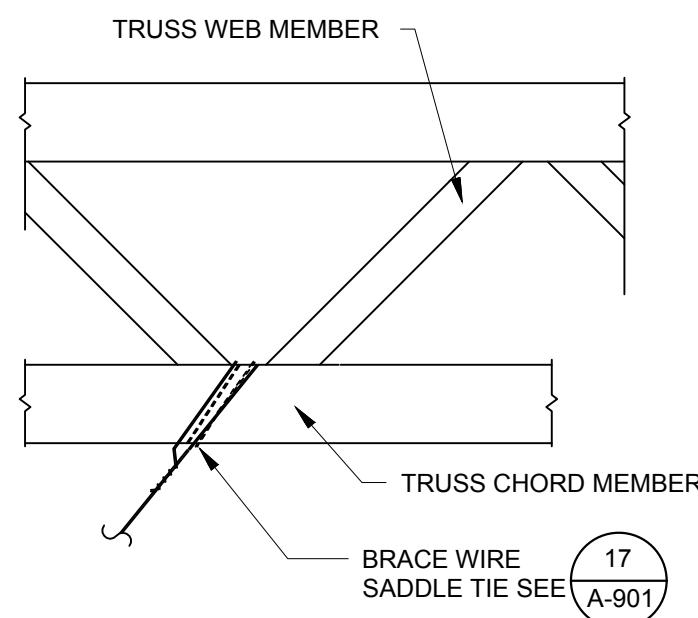
SCALE: 1-1/2" = 1'-0"



BRACING WIRE TO METAL DECK

SCALE: 1-1/2" = 1'-0"

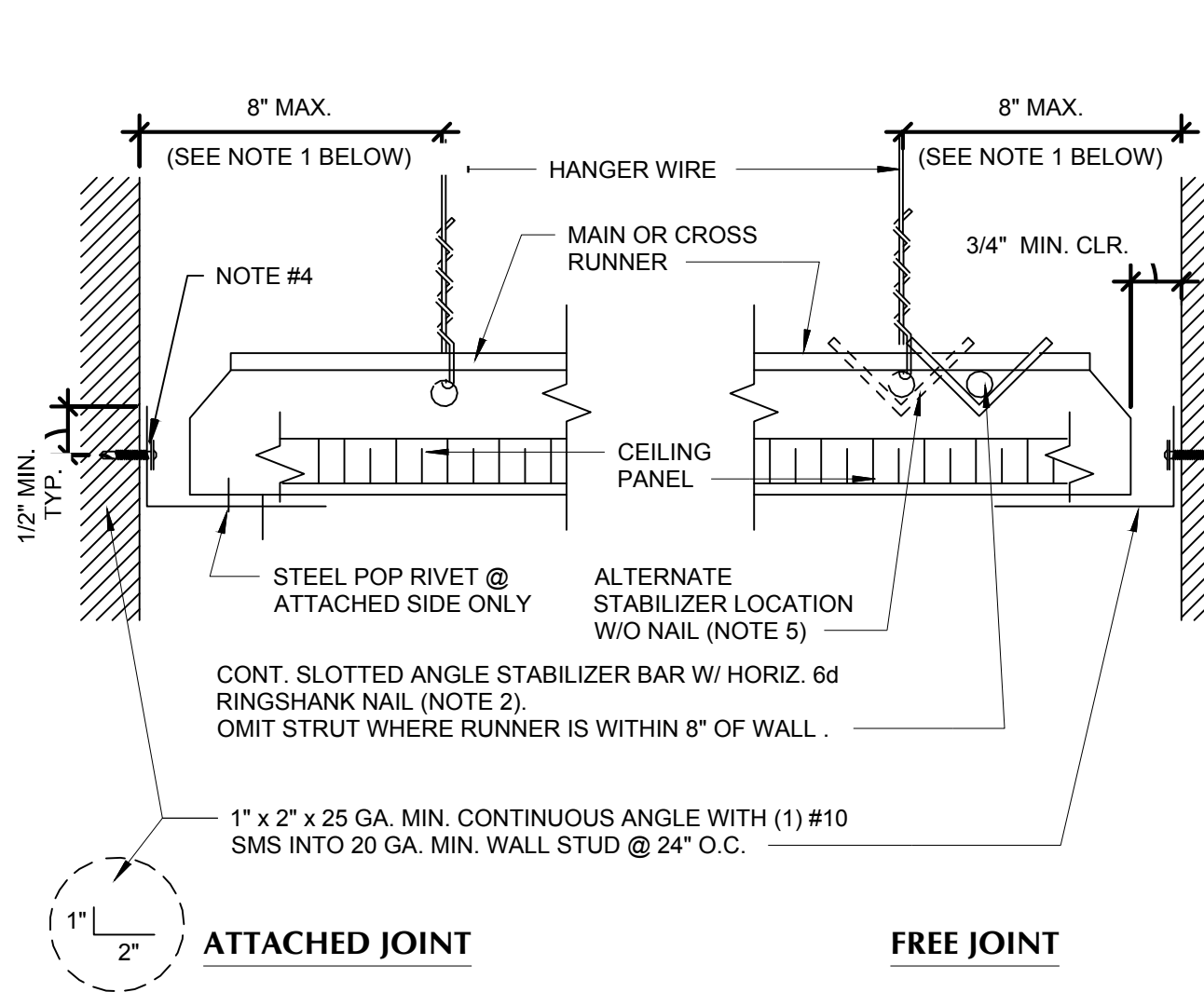
NOTES:
1. IF SELF-TAPPING SCREWS ARE USED WITH CONCRETE FILL, SET SCREWS
BEFORE PLACING CONCRETE.



BRACE WIRE AT WEB JOIST

SCALE: 1-1/2" = 1'-0"

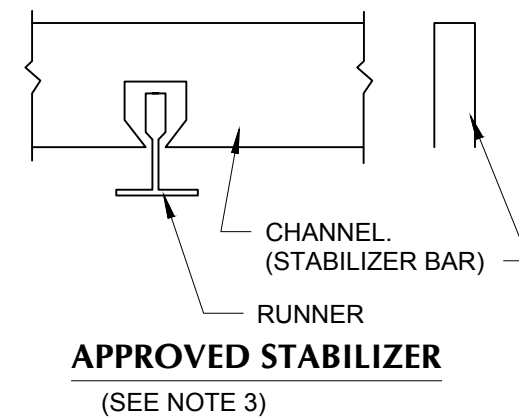
NOTES:
1. BRACE WIRE SHALL ALIGN PARALLEL WITH THE TRUSS BOTTOM CHORD
2. BRACE WIRE CONDITION SHOWN. HANGER WIRE WIRE CONDITION SIMILAR



ATTACHED JOINT

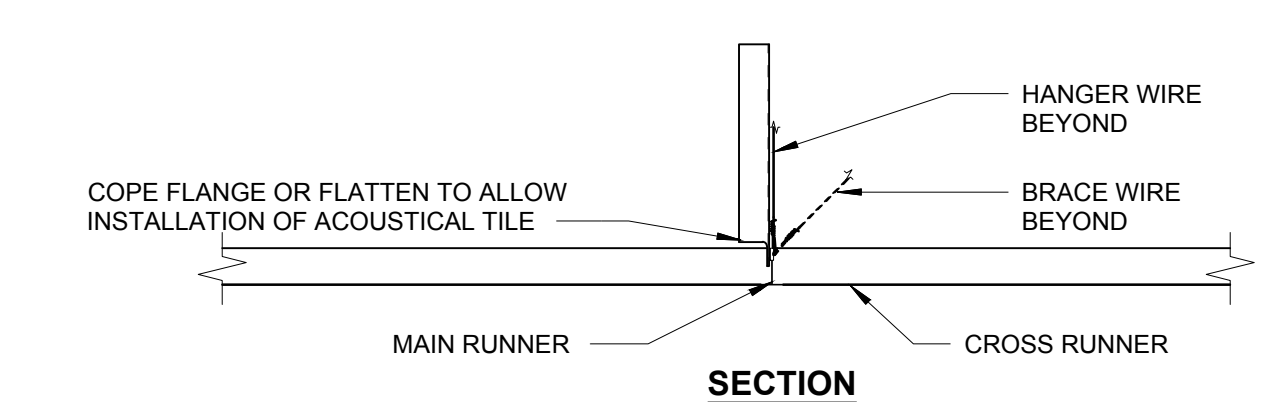
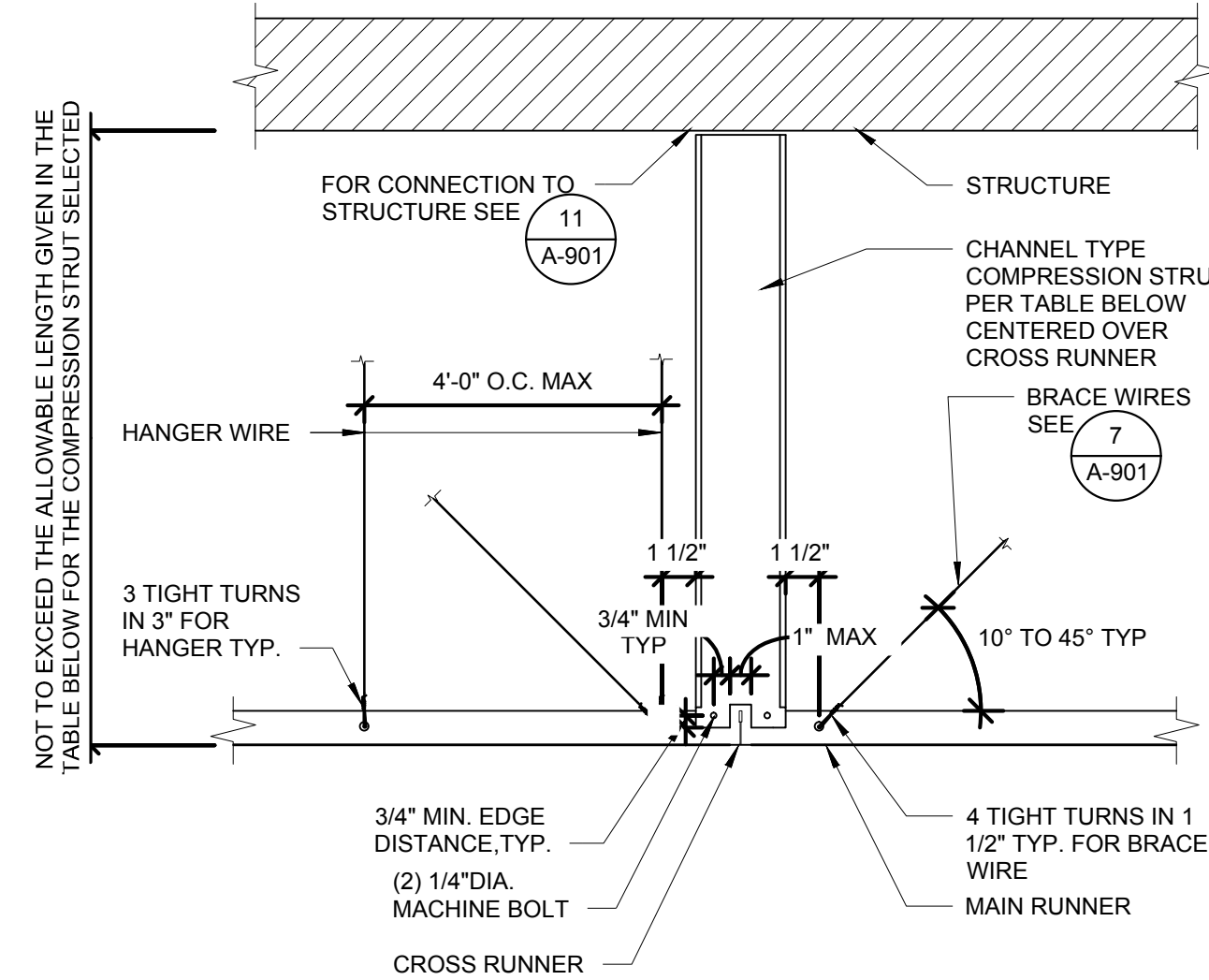
FREE JOINT

- NOTES:
- PROVIDE #12 GAGE HANGER WIRES AT THE ENDS OF ALL MAIN AND CROSS RUNNERS WITHIN EIGHT (8) INCHES OF THE SUPPORT OR WITHIN ONE-FOURTH (1/4) OF THE LENGTH OF THE END TEE, WHICHEVER IS LESS. FOR THE PERIMETER OF THE CEILING AREA, PERIMETER WIRES ARE NOT REQUIRED WHEN THE LENGTH OF THE END TEE IS EIGHT (8) INCHES OR LESS.
 - NAILS AT ENDS OF HORIZONTAL STABILIZERS ARE TO BE PLACED WITH NAIL HEAD TOWARD CENTER LINE OF SPAN OF STRUT.
 - STABILIZER BAR MAY BE SLOTTED APPROVED ANGLES OR CHANNELS WITH "DIAMOND POINTS" OF SPRING STEEL WHICH SNAP TIGHT TO PREVENT MOVEMENT OF STRUT.
 - (1) #10 SMS TO 20 GA. MIN. WALL STUD @ 24" O.C.



CEILING PERIMETER

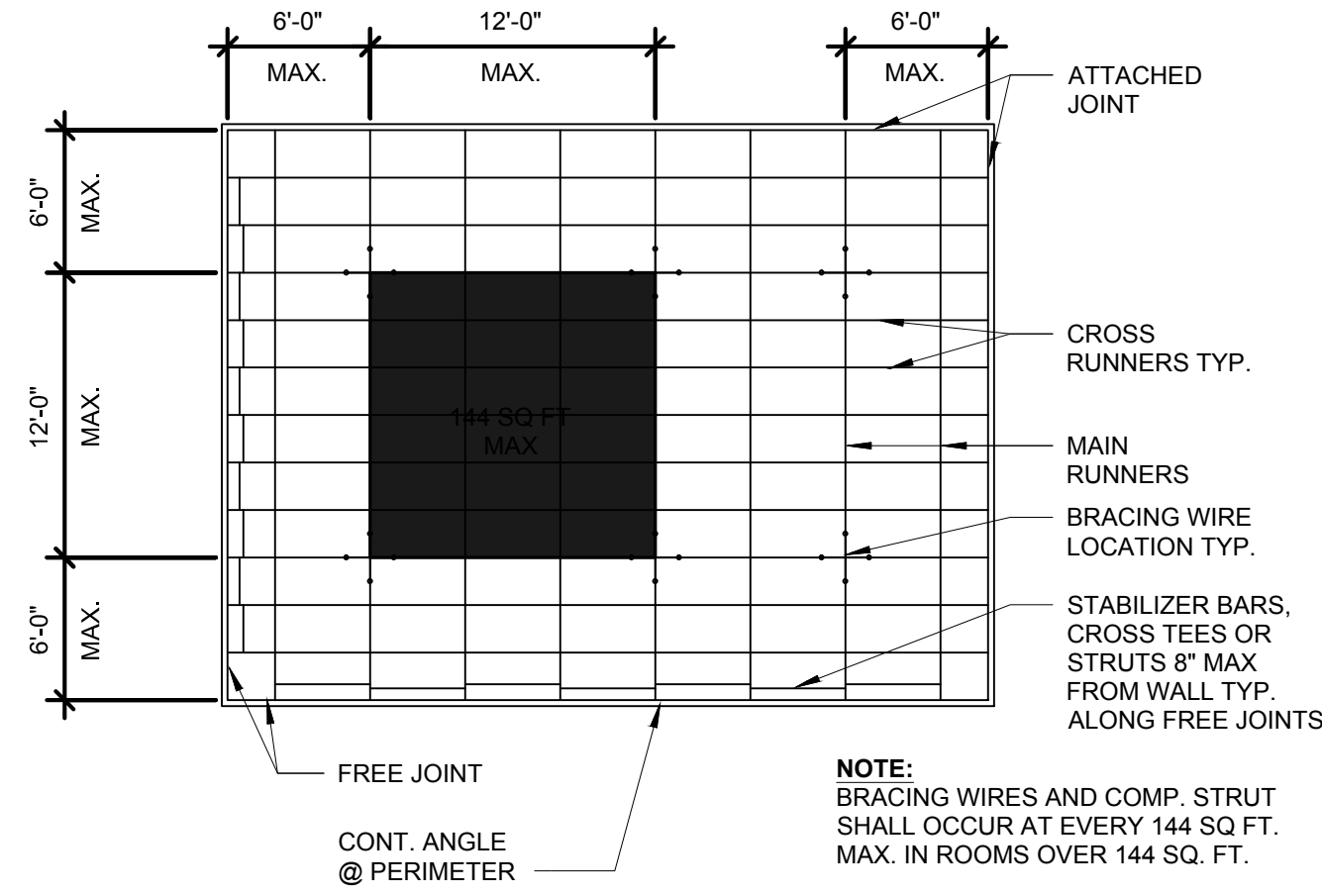
SCALE: 6" = 1'-0"



CHANNEL COMPRESSION STRUT	MAXIMUM LENGTH
250S125-43	5'-0"
250S137-43	6'-10"
362S137-43	8'-0"
250137-43	8'-10"
400S137-43	10'-10"

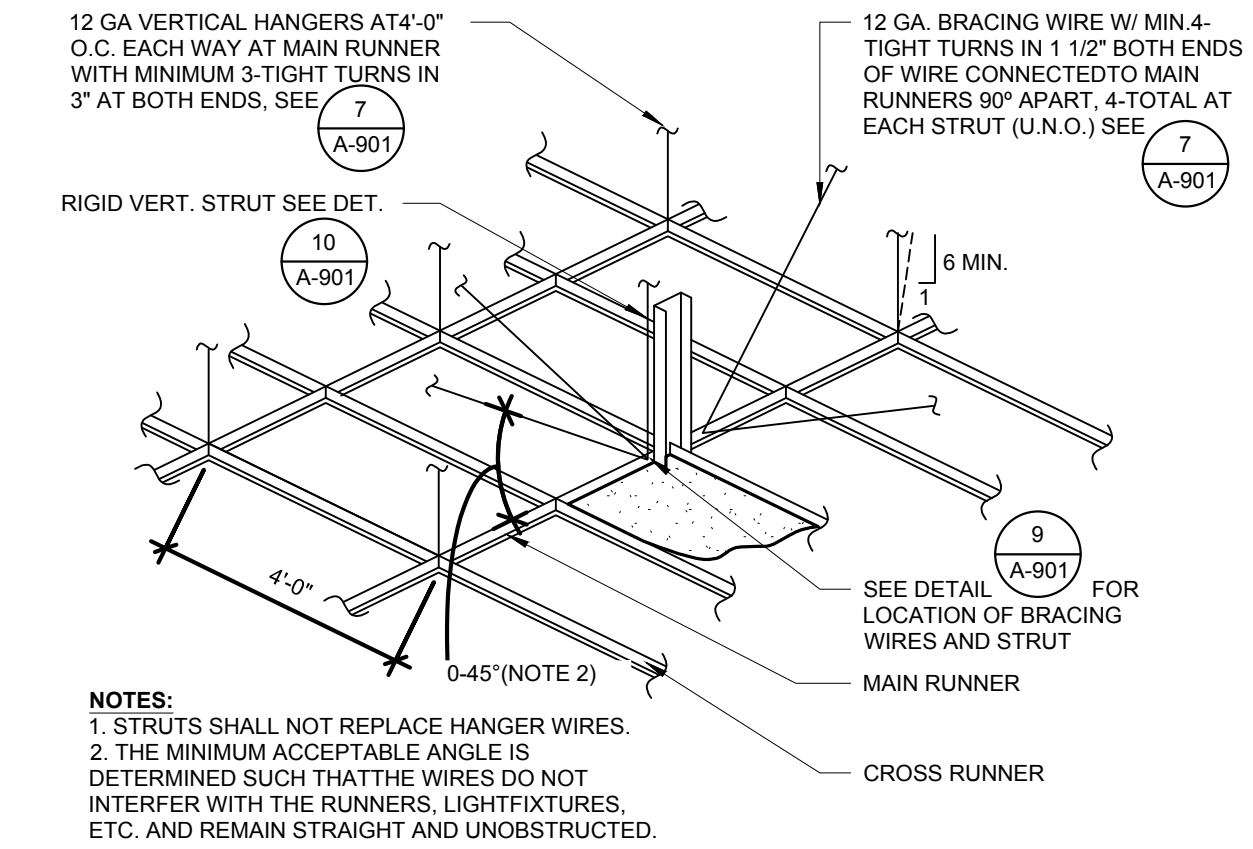
CHANNEL STRUT

SCALE: 1-1/2" = 1'-0"



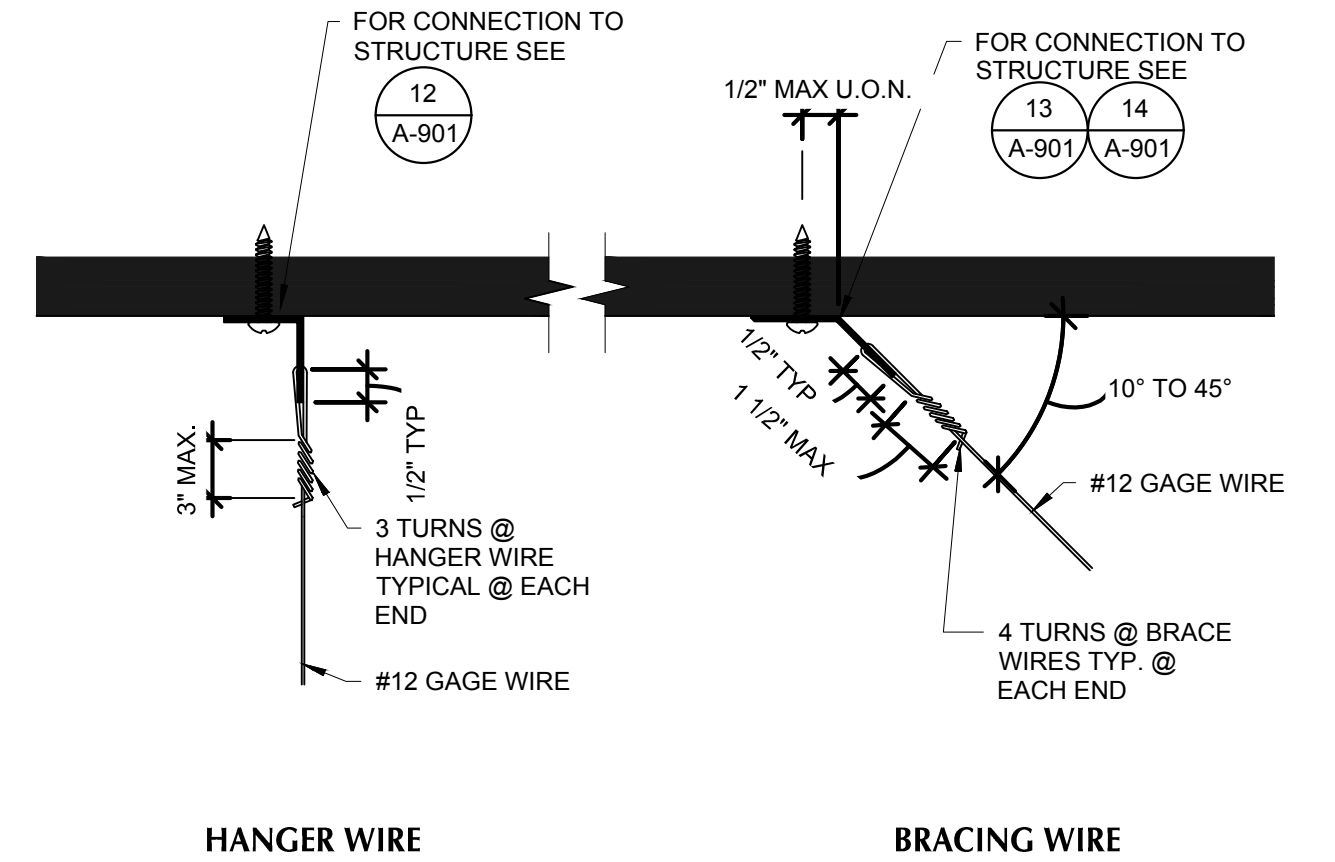
TYPICAL CEILING PLAN 12'x12'

SCALE: 1/8" = 1'-0"



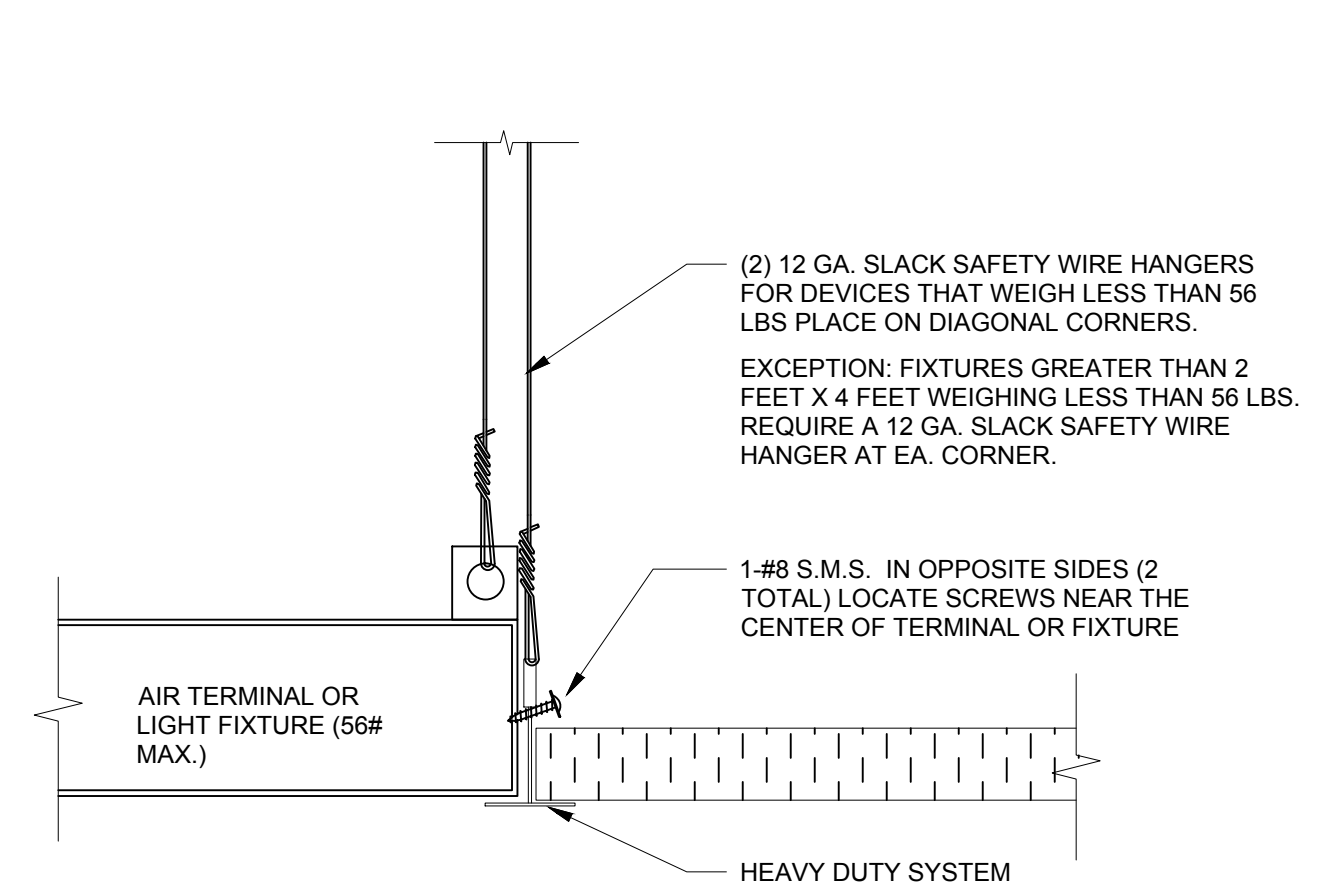
SUSPENSION & BRACING ASSEMBLY

SCALE: 3/8" = 1'-0"



TYPICAL WIRE TURNS

SCALE: 1-1/2" = 1'-0"



LIGHT FIXTURE OR AIR TERMINAL

SCALE: 1-1/2" = 1'-0"

PMSM
ARCHITECTS

19.6
ARCHITECTS

802 EAST COTA STREET, SUITE A
SANTA BARBARA, CA 93103
TEL (805) 963-1955

CONSULTANTS
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PLUMBING ENGINEER
P2S ENGINEERING, INC.
5000 East Spring Street, Suite 800
Long Beach, CA 90815
TEL (562) 497-2999 FAX (562) 497-2990

STRUCTURAL ENGINEER
STORK, WOLFE & ASSOCIATES
555 Chorro Street, Suite A1
San Luis Obispo, CA 93405
TEL (805) 548-8600

ARCHITECT STAMP CONSULTANT STAMP

BID SET
NOT
APPROVED

AGENCY APPROVAL

REVISIONS

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COMMUNITY COLLEGE DIST.
PRINT SHOP T.I. AT
CRAFTON HILLS
COLLEGE BL 14
11711 SAND CANYON ROAD
YUCAIPA, CA 92399

SHEET TITLE

CEILING DETAILS

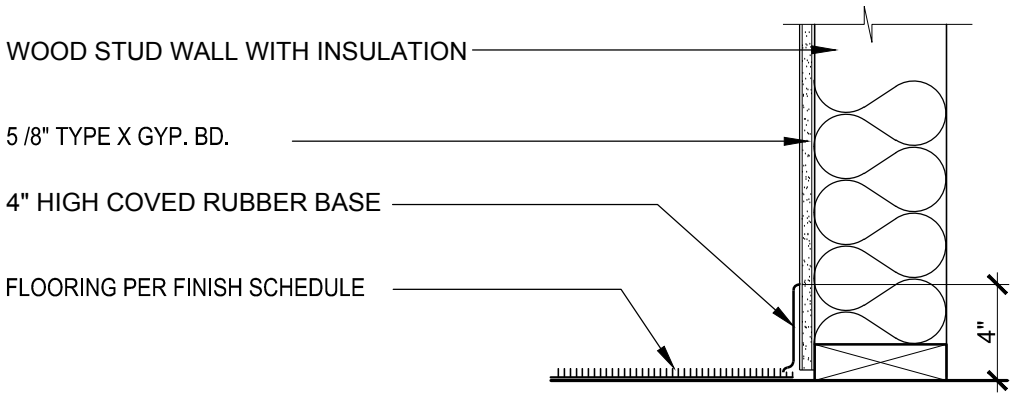
DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

A-901

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

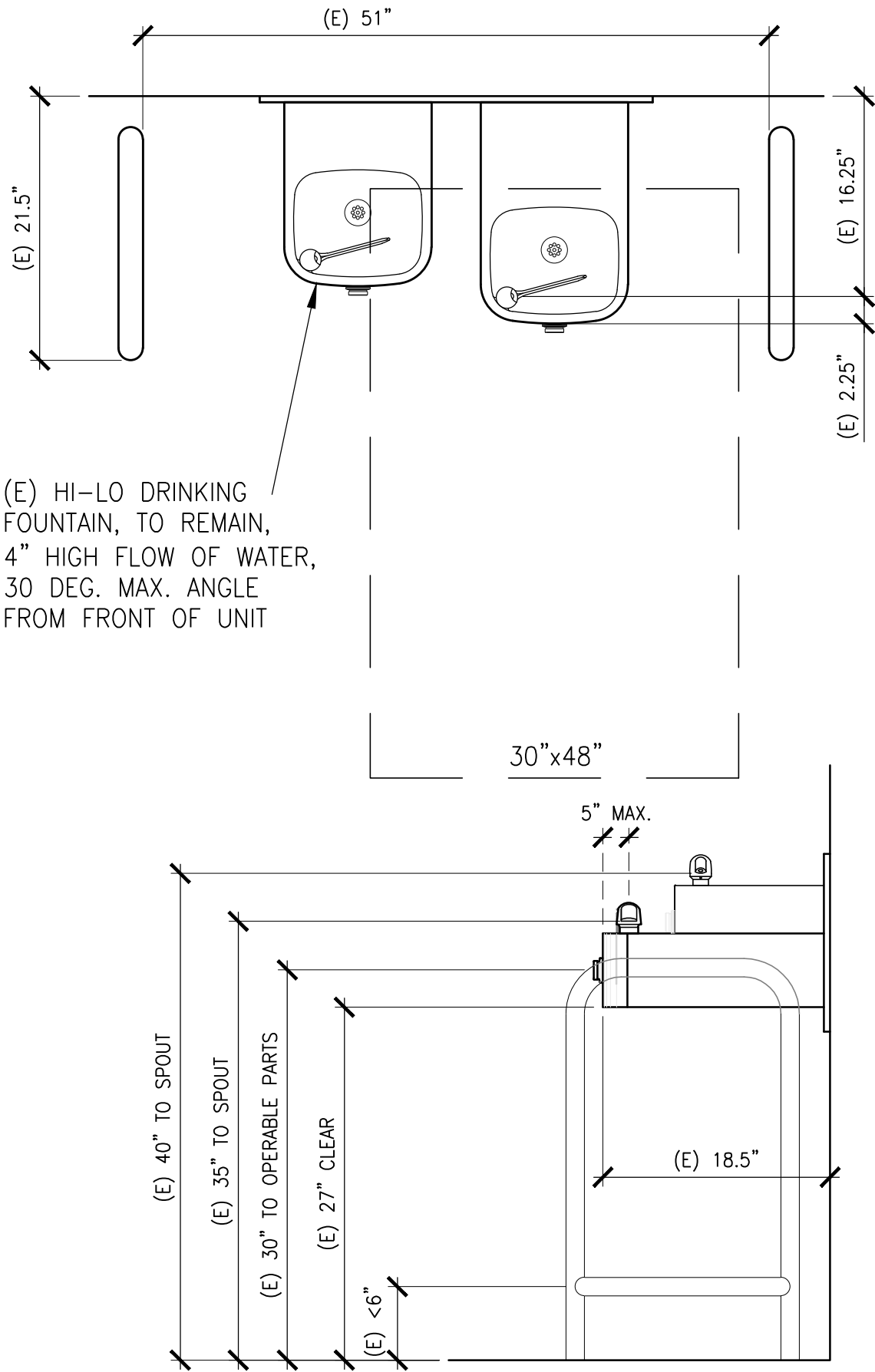
PLOT BY: HARTMAN
 PLOT DATE: Nov 12, 2018 - 8:12AM
 DRAWING NAME: IN:\2018\B1603 CHC District Print Shop T1.CDS THROUGH CA Drawings\BLOT FILES\B16.03-A-902.DWG



WALL BASE

SCALE: 1'-1/2" = 1'-0"

1



(E) DRIKING FOUNTAIN

SCALE: 1" = 1'-0"

3



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YUCAIPA, CA 92399

SHEET TITLE

DETAILS

DRAWN BY: MH/QP

JOB NUMBER: 18116.03

SHEET NO.

A-902

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

Abbreviations

APPLIES TO STRUCTURAL DRAWINGS ONLY

SYMBOLS USED AS ABBREVIATIONS

∠	AT
—	ANGLE
—	CENTERLINE
—	CHANNEL
—	PENNY
—	PERPENDICULAR
—	PLATE(S)
—	DIAMETER
—	?
—	SQUARE
—	WITH
wo/	WITHOUT
#	NUMBER
&	AND
o/	OVER

ABBREVIATIONS

A.C.	ASPHALT CONCRETE
ALT.	ALTERNATE
A.B.	ANCHOR BOLT(S)
APPROX.	APPROXIMATE(LY)
ARCH.	ARCHITECT(URAL)

BSMT.	BASEMENT
BRG.	BEARING
BM.	BEAM
BLK.	BLOCK
BLKG.	BLOCKING
B.O.	BOTTOM OF
B.O.F.	BOTTOM OF FOOTING
BLDG.	BUILDING
B.N.	BOUNDRY NAILING

C.	CAMBER
C.I.P.	CAST-IN-PLACE
CEM.	CEMENT
CNTR.	CENTER(ED)
CHAM.	CHAMFER(ED)
CLR.	CLEAR(ANCE)
CLS.	CLOSURE
C.J.	COLD JOINT

COL.	COLUMN(S)
CONC.	CONCRETE
C.M.U.	CONCRETE MASONRY UNIT
CONT.	CONTINUE(OUS)
CONTR.	CONTRACT(OR)
CORR.	CORRUGATED
CSK.	COUNTERSINK(SUNK)
C.F.	CUBIC FOOT
C.Y.	CUBIC YARD

DBL.	DOUBLE
D.L.	DEAD LOAD
DEP.	DEPRESS(ED)
DTL.	DETAIL(S)
DIAG.	DIAGONAL
DIA.	DIAMETER
DIM.	DIMENSION(S)
DF.	DOUGLAS FIR
DN.	DOWN

E.	EAST
E.N.	EDGE NAILING
EA.	EACH
E.F.	EACH FACE
(E)	EXISTING
ELEV.	ELEVATION
EQ.	EQUAL
E.B.	EXPANSION BOLT
EXP.	EXPOSE(D)
EXT.	EXTERIOR

F.N.	FIELD NAILING
FAB.	FABRICATE(D)(ION)
F.B.	FLOOR BEAM
F.O.	FACE OF
FOC.	FACE OF CONCRETE
FOM.	FACE OF MASONRY
FOS.	FACE OF STUD
F.S.	FAR SIDE
FIN.	FINISH
FFE.	FINISH FLOOR ELEVATION
FF.	FINISH FLOOR
FLR.	FLOOR
FT.	FOOT, FEET
FTG.	FOOTING
FDN.	FOUNDATION
FUT.	FUTURE

GA.	GAGE, GAUGE
GALV.	GALVANIZE(D)
GL.	GLASS, GLAZING
G.B.	GRADE BEAM
GLB.	GLUED LAMINATED BEAM
GYS.	GYP-SUM
GYPBD.	GYPBOARD

HDR.	HEADER
H.V.A.C.	HEATING/VENTILATING /AIR CONDITIONING
HT.	HEIGHT
HK.	HOOK(S)
HORIZ.	HORIZONTAL

INCL.	INCLUDE(D)(ING)
I.D.	INSIDE DIAMETER
IN.	INCHES
INS.	INSULATE(D)(ING)
INSP.	INSPECT(ING)(ION)
INT.	INTERIOR
INTM.	INTERMEDIATE

JT.	JOINT
JST.	JOIST

K.O.	KNOCKOUT
K.J.	KEYED JOINT

L.	LENGTH
LB.	POUND
LAM.	LAMINATE(D)
LDGR.	LEDGER
L.H.	LEFT HAND
L.L.	LIVE LOAD

M.B.	MACHINE BOLT
M.I.	MALLEABLE IRON
MFR.	MANUFACTURER
MAS.	MASONRY
M.L.	MASONRY LINTEL
MATL.	MATERIAL
MAX.	MAXIMUM
MECH.	MECHANICAL
MED.	MEDIUM
MMB.	MEMBRANE
M.F.D.	METAL FLOOR DECKING
M.R.D.	METAL ROOF DECKING
MDSP.	MIDSPAN
MISC.	MISCELLANEOUS

N.	NORTH
(N)	NEW
N.I.C.	NOT IN CONTRACT
N.T.S.	NOT TO SCALE
N.S.	NEAR SIDE

O.C.	ON CENTER
OPNG.	OPENING
O.W.J.	OPEN-WEB JOIST
OPP.	OPPOSITE
O.D.	OUTSIDE DIAMETER

PNL.	PANEL
PRLN.	PURLIN(S)
PAR.	PARALLEL
PARTN.	PARTITION
PVT.	PAVEMENT
PERF.	PERFORATE
PLY.	PLYWOOD
P.W.J.	PLYWOOD WEB JOIST
PT.	POINT
PVC.	POLYVINYLCHLORIDE
PCF.	POUNDS PER CUBIC FOOT
PLF.	POUNDS PER LINEAL FOOT
PSI.	POUNDS PER SQUARE INCH
PREFAB.	PREFABRICATE(D)
PREFIN.	PREFINISH(ED)
P.T.D.F.	PRESSURE TREATED DOUGLAS FIR
PL.	PLATE(S)
PLN.	PROPERTY LINE

RAD.	RADIUS
RLNG.	RAILING
REF.	REFER(ENCE)
REINF.	REINFORCE(D)
REQ.	REQUIRE(D)
REV.	REVERSE(D)
REV.	REVISE(ION)
R.H.	RIGHT HAND
R.D.	ROOF DRAIN
RFG.	ROOFING
RM.	ROOM
R.O.	ROUGH OPENING

S.J.	SAWED JOINT
SCHED.	SCHEDULE
SEC.	SECTION
SHT.	SHEET or SHEATHING
SIMP.	"SIMPSON" (a manufacturer)

SIM.	SIMILAR
S.	SOUTH
SPEC.	SPECIFICATION
SQ.	SQUARE
STAG.	STAGGER(ED)
STL.	STEEL
STD.	STANDARD
STRL.	STRUCTURAL
SYM.	SYMMETRICAL

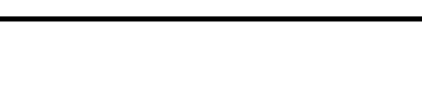
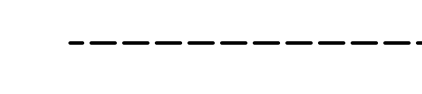
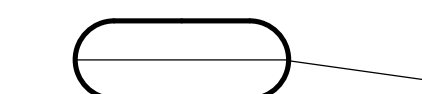
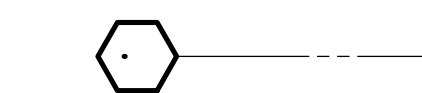
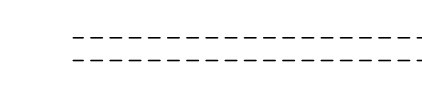
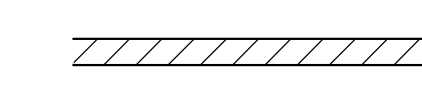
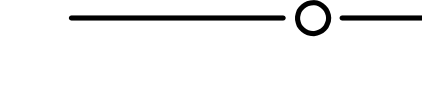
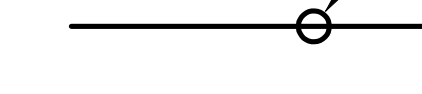
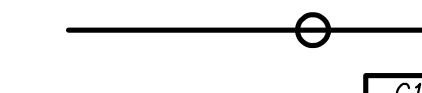
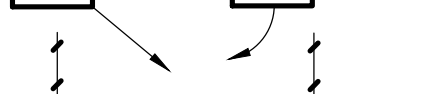
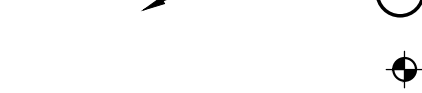
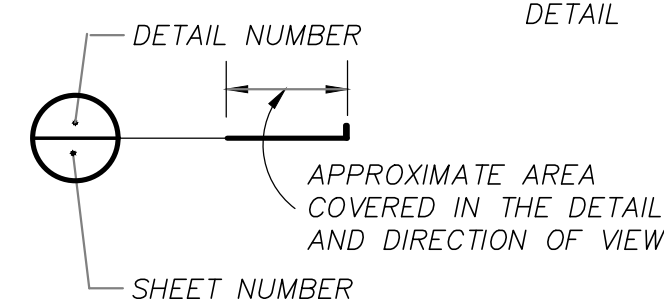
THRD.	THREAD(ED)
THK.	THICK
T&G.	TONGUE & GROOVE
T.O.	TOP OF
TOC.	TOP OF CONCRETE
TOCB.	TOP OF CURB
TOF.	TOP OF FOOTING
TOG.	TOP OF GRADE
TOM.	TOP OF MASONRY
TOP.	TOP OF PAVING
TOPL.	TOP OF PLATE
TOS.	TOP OF SLAB
TOSHTG.	TOP OF SHEATHING
TOSTL.	TOP OF STEEL
TOW.	TOP OF WALL
TYP.	TYPICAL

U.N.O.	UNLESS NOTED OTHERWISE
V.B.	VAPOR BARRIER
VNR.	VENEER
VERT.	VERTICAL

WF.	WIDE FLANGE
WWF.	WELDED WIRE FABRIC
WP.	WATERPROOFING
W.	WEST
WD.	WIDTH or WIDE
WI.	WOOD
W.I.	WROUGHT IRON
WM.	WIRE MESH

Symbols

APPLIES TO STRUCTURAL DRAWINGS ONLY



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A DETAIL CUT WHERE THE DIRECTION OF THE VIEW IS IDENTICAL IN EITHER DIRECTION OR IS A MIRROR IMAGE OF EACH OTHER

DETAIL CUT WHERE MORE THAN ONE DETAIL IS REQUIRED FOR THE ENTIRE PICTURE

SECTION

KEYED NOTE NUMBER

BOLTED HOLDDOWNS

STRAP TYPE HOLDDOWNS

CHANGE IN ELEVATION

INDICATES SCHEDULED ITEM. REFER TO LIST BELOW FOR ITEMS SCHEDULED.

INDICATES SCHEDULED ITEM. REFER TO LIST BELOW FOR ITEMS SCHEDULED.

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INDICATES SCHEDULED ITEM. REFER TO LIST BELOW FOR ITEMS SCHEDULED.

Structural General Notes

APPLIES TO STRUCTURAL DRAWINGS ONLY

GENERAL

- All materials and workmanship are subject to the review of the Architect and Structural Engineer.
- Report any and all discrepancies, ambiguities, unclear items or items that are subject to more than one interpretation, on the Drawings and/or Specifications to the Structural Engineer for clarification before proceeding with Work.
- All Work done under this contract is to comply with the 2016 edition of the California Building Code.
- Design and install all temporary bracing and shoring to ensure the safety of the Work until it is in its completed form. When required by law, employ a Civil Engineer to design shoring, bracing, and installation plans for structural items. Verify all dimensions prior to starting Work. The Architect and Structural Engineer are to be notified of any discrepancies or inconsistencies. Check and coordinate all dimensions. See architectural Drawings for dimensions and non-structural items not shown on these Plans. Do not scale the Drawings to obtain dimensions.
- All scaffolding and shoring is to comply with the rules and regulations of the Industrial Safety Commission of the State of California.
- The Structural Engineer will provide only periodic observation of the Work.
- Fees or costs associated with the redesign or modification of these Plans by the Architect or Structural Engineer as a result of deviation by the Contractor from the Plans and Specifications, or due to errors, faulty materials or faulty workmanship, is to be paid to the Structural Engineer by the Contractor.
- The Contractor is required to assume sole and complete responsibility for job site conditions during the course of construction of the project, including safety of all persons and property. This requirement applies continuously and is not limited to normal working hours. The Contractor further agrees to defend, indemnify and hold harmless the Structural Engineer from any and all liability, real or alleged, in connection with the performance of Work of this project, excepting liability arising from the sole negligence of the Structural Engineer.
- Neither the professional activities nor the presence of the Structural Engineer at the construction site relieves the Contractor of his obligation, duties and responsibilities for construction means, methods, sequences, techniques and procedures necessary for the Contractor to complete the Work in accordance with the Plans and Specifications in a manner to ensure the health and safety of persons who enter the construction site.
- Bidders must visit the building site and familiarize themselves with the existing conditions. Discrepancies or deletions must be brought to the attention of the Architect and Structural Engineer before bid date for correction.
- All work has been done in a manner as required for new structures.
- Protect adjoining property and buildings as defined in Section 1804A.1 of the California Building Code.

SAWN LUMBER

- Framing and sheathing grades are as follows:
Joists and rafters Doug Fir No. 1
4x & 6x beams/headers Doug Fir No. 1 or better
14x14 truss members Doug Fir No. 1
Wall studs Doug Fir No. 1
6x6, 8x8 posts Doug Fir No. 1
Blocking, stripping, & misc Doug Fir No. 2
Plywood and OSB APA sheathing rated Struct 1, Exposure 1 conforming to U.S. Product Standards DOC PS-1 & DOC PS-2.
- For minimum nailing per California Building Code, see typical detail sheet.
- Anchor non-bearing interior stud walls on concrete slabs with 3/8" diameter x 6" anchor bolts at 4'-0" o.c. or .145" diameter powder driven pins with 1" space powder driven anchors at 32" o.c., and a maximum of 9" from ends. Use a minimum of 2 fasteners per plate. Use low velocity X U15 fasteners by HILTI (ICC#ESR-2269), or 1524 fasteners by Ramset (ICC#EST-1799), or other approved equal (ICC reports are required).
- Provide minimum anchorage of bearing walls and exterior walls with 3/8" diameter x 12" anchor bolts at 4'-0" o.c. with a bolt between 4" and 12" from the end of each piece.
- Drill holes in wood for bolts 1/8" larger than the nominal size of the bolt, unless noted otherwise on the Drawings.
- Provide all bolts with standard cut washers under heads and/or nuts where in contact with wood.
- Where stud wall terminates at a concrete or masonry wall, fasten the last stud to the wall with 3/8" diameter x 6" long bolts at the top, bottom, and mid-height of the stud. Maximum vertical spacing of anchors shall be 6'-0".
- Pre-drill lag bolt holes such that the clearance hole for the shank shall have the same diameter as the shank, and the same depth of penetration as the length of the unthreaded shank. The lead hole for the threaded portion shall have a diameter equal to 40% to 70% of the shank diameter in the wood and a length equal to at least the length of the threaded portion. The threaded portion shall apply to lag screws of greater diameters. The threaded portion of the lag screw shall be inserted in its lead hole by turning with a wrench, not by driving with a hammer.
- Stagger splices in upper and lower plates at the top of stud walls at least 4'-0". Refer to typical detail.
- Minimum dimension of any plywood sheet is to be 24" and the minimum area is to be 8 square feet. Smaller dimensioned sheets may be used only if all edges are solid blocked and edge nailed.
- Provide 1/8" gap at all adjoining plywood panel edges.
- All timber connectors are to be galvanized, or painted with corrosion resistant polymer paint.
- Posts or columns supported by a concrete slab or footing that is in direct contact with the earth shall be preservative treated wood.
- Members exposed to view: Select for best appearance available in grade specified, free of heart center rings, checks, and splits. Grade stamps exposed to view will not be acceptable. Remove old stains or gouges prior to installation. Use Douglas Fir pressure impregnated lumber for sill plates resting on or against concrete or masonry and at other exterior locations. Use a Walmat CCA-C product or approved equal. When pressure treated lumber is in contact with steel connectors, the pressure treatment compound shall be no more corrosive than CCA-A. Wood treatment to comply with CBC Section 2303A.1.8 which references AWPA Standard U1 & M4.
- Fasteners in contact with preservative-treated wood shall be of hot-dipped zinc-coated galvanized steel, stainless steel, silicon bronze or copper. Fasteners other than nails, timber rivets, wood screws, and lag screws shall be permitted to be of mechanically deposited zinc-coated steel with coating weights in accordance with ASTM B 695, Class 55 minimum. Connectors that are used in exterior applications and in contact with preservative-treated wood shall have coating types and weights in accordance with the treated wood or connector manufacturer's recommendations. In the absence of manufacturer's recommendations, a minimum of ASTM A 653, type G185 zinc-coated galvanized steel, or equivalent, shall be used. Exception: Plain carbon steel fasteners in SBX/DOT and zinc borate preservative treated wood in an interior, dry environment shall be permitted.
- Fasteners for fire-retardant-treated wood used in exterior applications or wet or damp locations shall be of hot-dipped zinc-coated galvanized steel, stainless steel, silicon bronze or copper. Fasteners other than nails, timber rivets, wood screws and lag screws shall be permitted to be of mechanically deposited zinc-coated steel with coating weights in accordance with ASTM B 695, Class 55 minimum.
- Fasteners for fire-retardant-treated wood used in interior locations shall be in accordance with the manufacturer's recommendations. In the absence of manufacturer's recommendations, see previous note.

CONCRETE

- All concrete shall have a minimum 28-day ultimate compressive strength (f'c) as follows:
Foundations & slabs-on-grade 3,000 psi, NWC
- Reinforcing bars are to be of intermediate grade conforming to ASTM A 615, grade 40 for #2 and #3 bars and grade 60 for #4 bars and larger.
- Cement is to be type II, low alkali (no higher than .4%), conforming to ASTM C-150. Up to a maximum of 18% of cement may be substituted with Fly Ash (type "F").
- All aggregate used in concrete are to conform to ASTM C-33. Aggregate shall be uniformly graded, with the maximum aggregate size required to be 1" to 3/4".
- Coarse and fine aggregate (sand) are to come from a source proven to have non-reactive characteristics. Coarse aggregate which is heavy media processed (Saticoy, Siquoc), Santa Margarita rock, or San Gabriel rock will be considered as meeting the criteria of non-reactivity. Moorpark sand (Quality, Best, Blue Star) will be considered as meeting the requirements

PLOT BY: GREG
PLOT DATE: Nov 02, 2018 - 11:28AM
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Special Inspections

APPLIES TO STRUCTURAL DRAWINGS ONLY

NOTIFICATION

Notify the Structural Engineer 48 hours before the following times:

- Prior to the time that construction begins.
- After foundation excavations have been made and prior to placing reinforcing steel and formwork.
- Prior to all concrete pours.
- When rough framing is completed and prior to start of finish work.
- Prior to covering any plywood sheathing nailing & shear wall anchors/holdowns

STRUCTURAL OBSERVATION

Observation of the construction shall be provided by the Architect or Structural Engineer in General Responsible Charge as set forth in Title 24, Part I. At the conclusion of the work included in this permit, the structural observer shall submit to the building official a written statement that the site visits have been made and identify any reported deficiencies that, to the best of the structural observer's knowledge, have not been resolved. Structural observation shall be provided for the following stages of construction.

- Prior to concrete pours to observe excavation dimensions, reinforcement, and required embedded items.
- Prior to the covering of any structural framing, diaphragms, shear wall anchors/holdowns.

SPECIAL INSPECTIONS (CBC Sections 1704A & 1705A)

The owner or the architect of record, acting as the owner's agent, shall employ one or more special inspectors who are approved by DSA who shall provide inspections during construction on the following, but not limited to, types of work:

- Reinforced concrete per Table 1705A.3.
 - Required for all concrete designed for f'c exceeding 2,500 psi.
 - Exceptions – Special inspections shall not be required for:
 - Concrete patios, driveways and sidewalks, on grade.
- Steel Construction per Section 1705A.2 and Table 1705A.2.1
 - Welding not performed in an approved fabricator's shop per Section 1705A.2.2.1
Cost of Special Inspection for field welds not shown on Plans to be borne by Owner. Cost of Special Inspection on welds that are not specifically called out on the Plans as field welds to be borne by Owner.
 - Steel construction details per Section 1705A.2.
- Seismic resistance per Section 1705A.11 as applicable.
- Materials and systems required to be installed in accordance with additional manufacturer's instructions per Section 1705A.3.1, such as adhesive installed bolts or dowels.
- Periodic special inspection for anchorage of electrical equipment per section 1705A.11.6. Refer to project Statement of Structural Tests and Special Inspections Form DSA-103 for a detailed scope of required testing and inspections.

TABLE 1705A.3
REQUIRED VERIFICATION AND INSPECTION OF CONCRETE CONSTRUCTION

VERIFICATION AND INSPECTION	CONTINUOUS	PERIODIC	REFERENCED STANDARD ^a	CBC REFERENCE
1. Inspection of reinforcing steel, including prestressing tendons, and placement.	—	X	ACI 318: 3.5,7.1–7.7	1910A.4
2. Inspection of reinforcing steel, welding in accordance with Table 1705.2.2, Item 2b.	—	—	AWS D1.4 ACI 318: 3.5.2	—
3. Inspection of anchors cast in concrete where allowable loads have been increased or where strength design is used.	X	—	ACI 318: 8.1.3, 21.2.8	1908A.5, 1909A.1
4. Inspection of anchors post-installed in hardened concrete members ^b .	—	X	ACI 318: 3.8.6, 8.1.3, 21.2.8	1909A.1
5. Verify use of required design mix.	—	X	ACI 318: Ch. 4, 5.2–5.4	1904A.2, 1910A.2, 1910A.3
6. At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.	X	—	ASTM C 172 ASTM C 31 ACI 318: 5.6, 5.8	1910A.10
7. Inspection of concrete and shotcrete placement for proper application techniques.	X	—	ACI 318: 5.9, 5.10	1910A.6, 1910A.7, 1910A.8
8. Inspection for maintenance of specified curing temperature and techniques.	—	X	ACI 318: 5.11–5.13	1910A.9
9. Inspection of prestressed concrete: a. Application of prestressing forces. b. Grouting of bonded prestressing tendons in the seismic-force-resisting system.	X X	—	ACI 318: 18.20 ACI 318: 18.18.4	—
10. Erection of precast concrete members.	—	X	ACI 318: Ch. 16	—
11. Verification of in-situ concrete strength, prior to stressing of tendons in posttensioned concrete and prior to removal of shores and forms from beams and structural slabs.	—	X	ACI 318: 6.2	—
12. Inspect formwork for shape, location and dimensions of the concrete member being formed.	—	X	ACI 318: 6.1.1	—
13. Inspection of adhesive anchors in horizontal and upwardly inclined positions. ^c	—	X	ACI 318: D.9.2.2	—

For SI: 1 inch=25.4 mm.

a. Where applicable, see also Section 1705A.1, Special inspection for seismic resistance.

b. Specific requirements for special inspection shall be included in the research report for the anchor issued by an approved source in accordance with ACI 355.2 or other qualification procedures. Where specific requirements are not provided, special inspection requirements shall be specified by the registered design professional and shall be approved by the building official prior to the commencement of the work.

c. Installation of all adhesive anchors in horizontal and upwardly inclined positions shall be performed by an ACI/CRSI certified adhesive anchor installer.

TABLE 1705A.2.1
REQUIRED VERIFICATION AND INSPECTION OF STEEL CONSTRUCTION

VERIFICATION AND INSPECTION	CONTINUOUS	PERIODIC	REFERENCED STANDARD ^a	CBC REFERENCE
1. Material verification of high-strength bolts, nuts and washers:				
a. Identification markings to conform to ASTM standards specified in the approved construction documents.	—	X	Applicable ASTM material specifications; AISC 360, Section A3.3	—
b. Manufacturer's certificate of compliance required.	—	X	—	—
2. Inspection of high-strength bolting:				
a. Snug-tight joints.	—	X	AISC 360, Section M2.5	
b. Pretensioned and slip-critical joints using turn-of-nut with matchmarking, twist-off bolt or direct tension indicator methods of installation.	—	X		
c. Pretensioned and slip-critical joints using turn-of-nut without matchmarking or calibrated wrench methods of installation.	X	—		
3. Material verification of structural steel and cold-formed steel deck:				
a. For structural steel, identification markings to conform to AISC 360.	—	X	AISC 360, Section M5.5	2203A.1
b. For other steel, identification markings to conform to ASTM standards specified in the approved construction documents.	—	X	Applicable ASTM material standards	
c. Manufacturers' certified mill test reports.	—	X	ASTM A 6 or ASTM A 568	
4. Material verification of weld filler materials:				
a. Identification markings to conform to AWS specification in the approved construction documents.	—	X	AISC 360, Section A3.5 and applicable AWS A5 documents	—
b. Manufacturer's certificate of compliance required.	—	X	—	—
5. Inspection of welding:				
a. Structural steel:				
1) Complete and partial penetration groove welds.	X	—	AWS D1.1	1705A.2.2
2) Multipass fillet welds.	X	—		
3) Single-pass fillet welds > 5/16"	X	—		
4) Plug and slot welds.	X	—		
5) Single-pass fillet welds ≤ 5/16"	—	X	AWS D1.3	—
6) Floor and roof deck welds.	—	X		
b. Reinforcing steel:				
1) Verification of weldability of reinforcing steel other than ASTM A 706.	—	X	AWS D1.4 ACI 318: Section 3.5.2	—
2) Reinforcing steel-resisting flexural and axial forces in intermediate and special moment frames, and boundary elements of special structural walls of concrete and shear reinforcement.	X	—		
3) Shear reinforcement.	X	—		
4) Other reinforcing steel.	—	X		
6. Inspection of steel frame joint details for compliance:				
a. Details such as bracing and stiffening.	—	X	—	1705A.2.2
b. Member locations.	—	X		
c. Application of joint details at each connection.	—	X		

For SI: 1 inch=25.4 mm.

a. Where applicable, see also Section 1705A.11, Special inspection for seismic resistance.



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SHEET TITLE

INSPECTION
TABLES

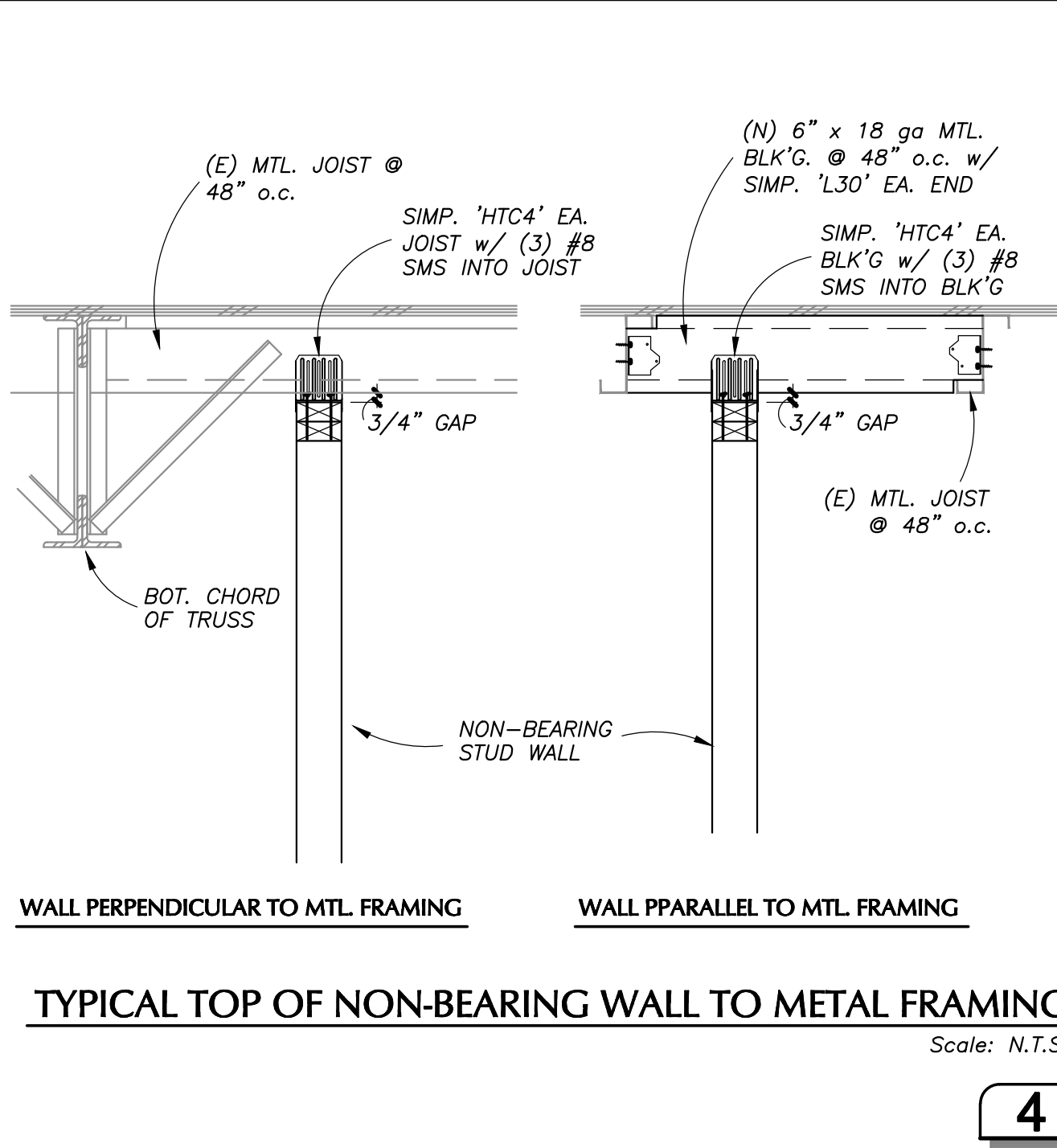
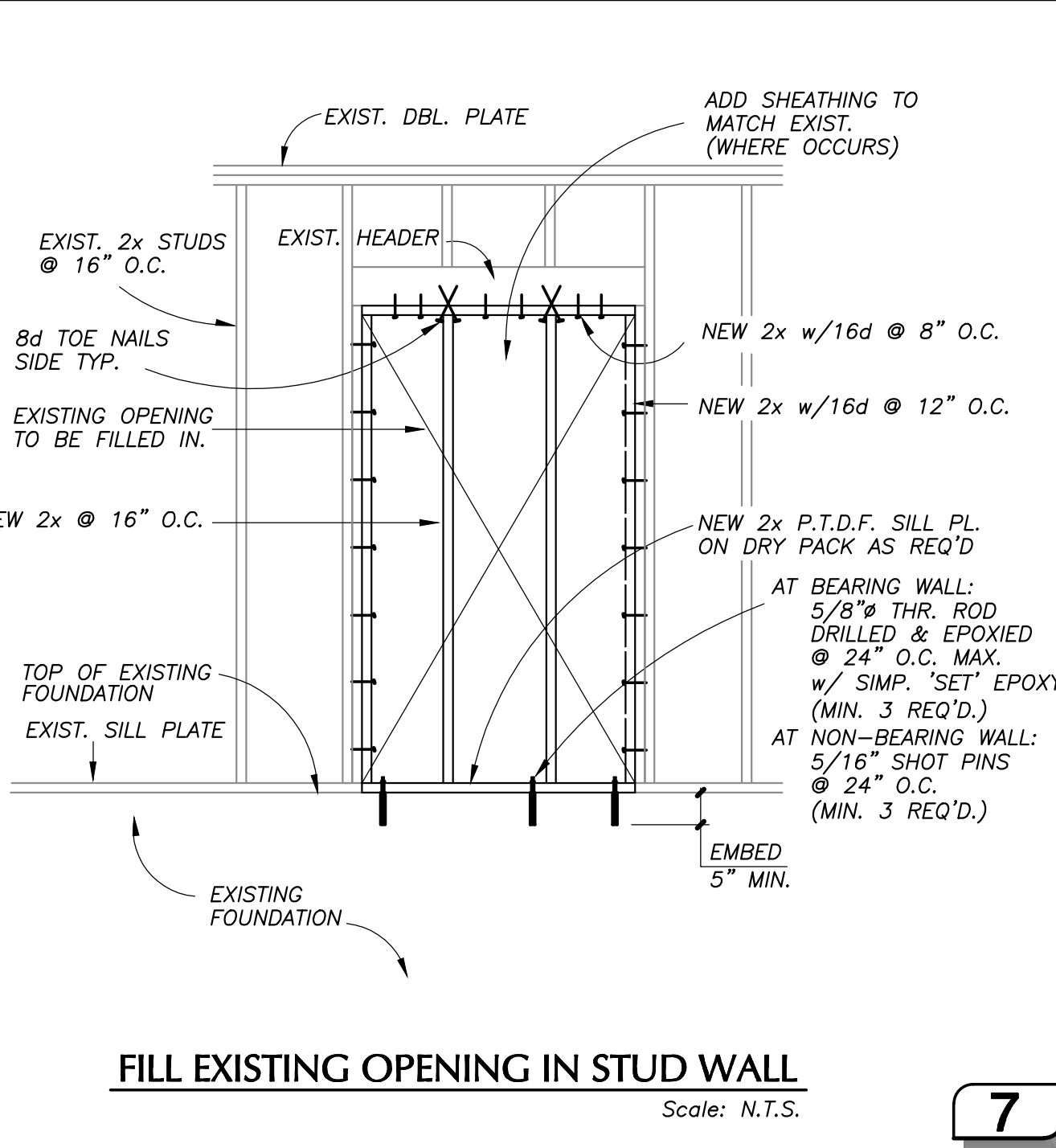
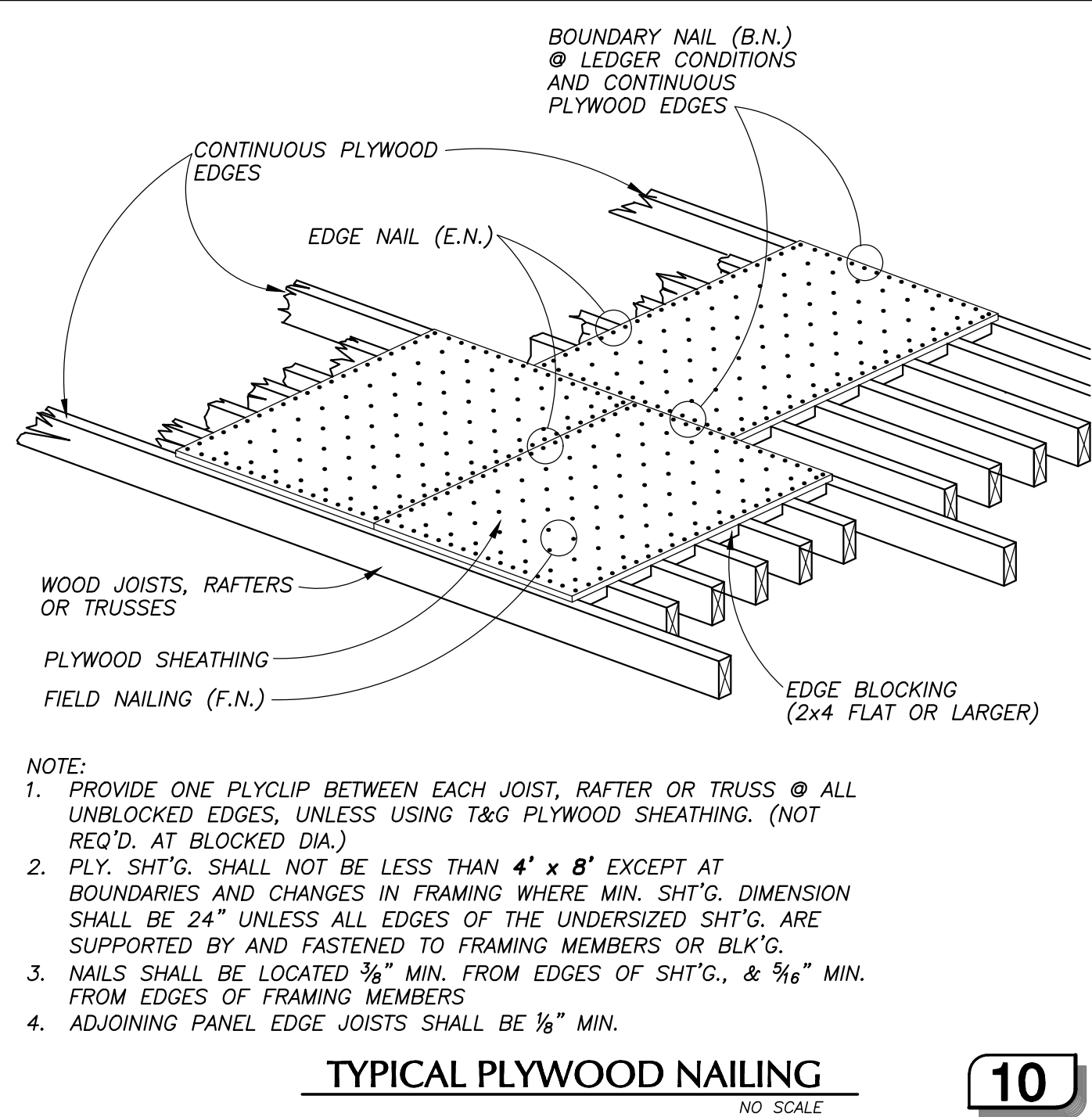
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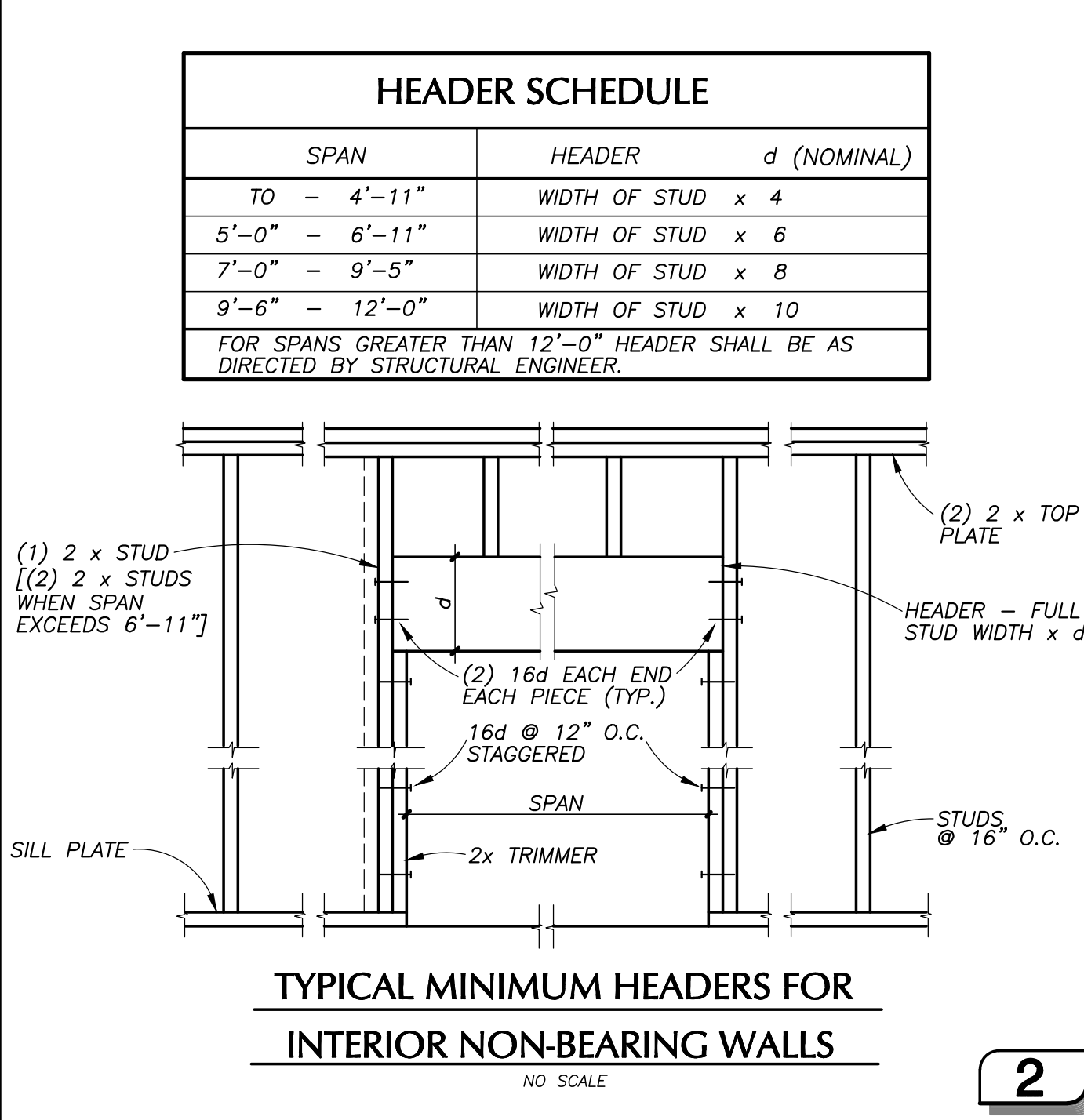
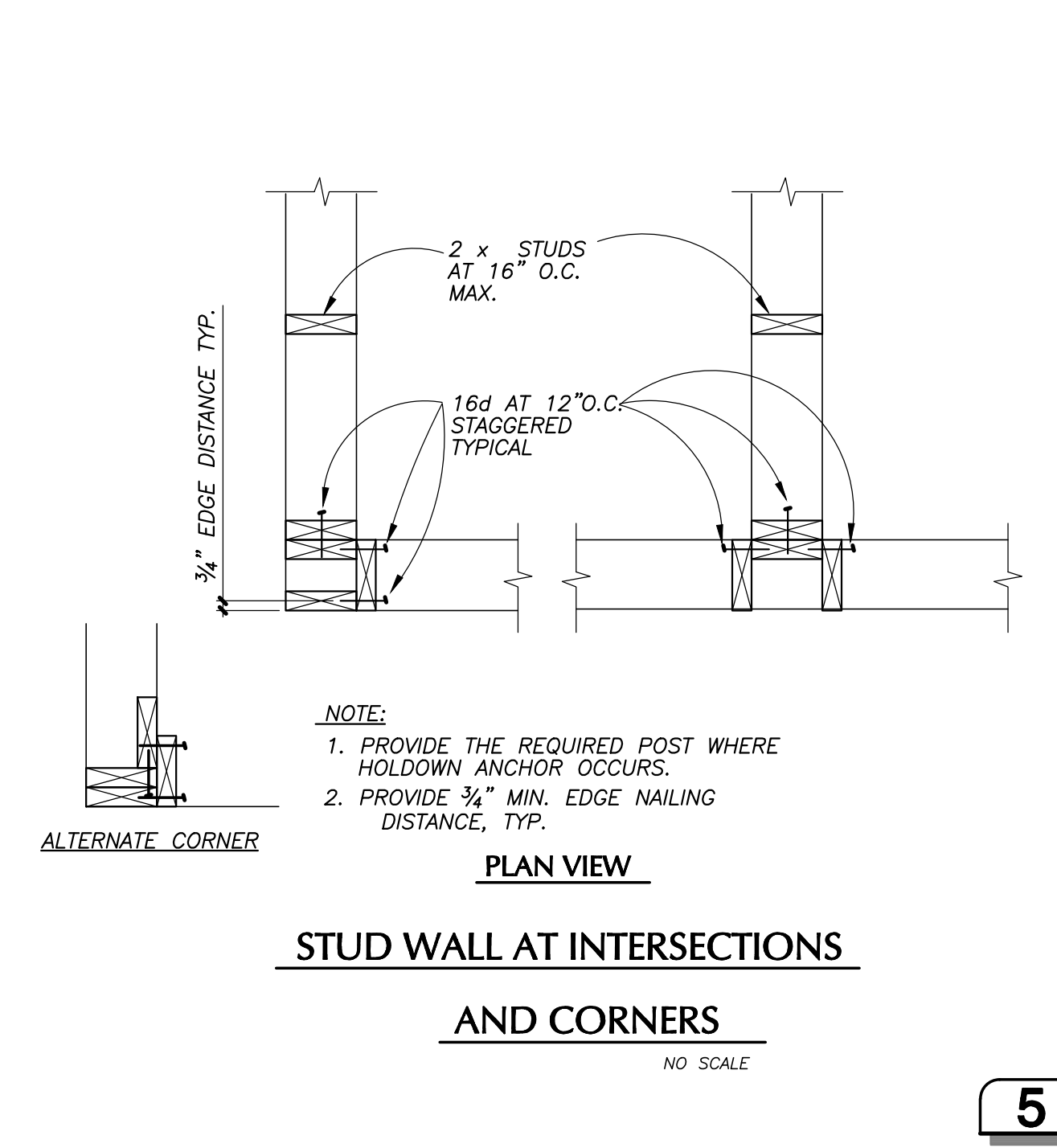
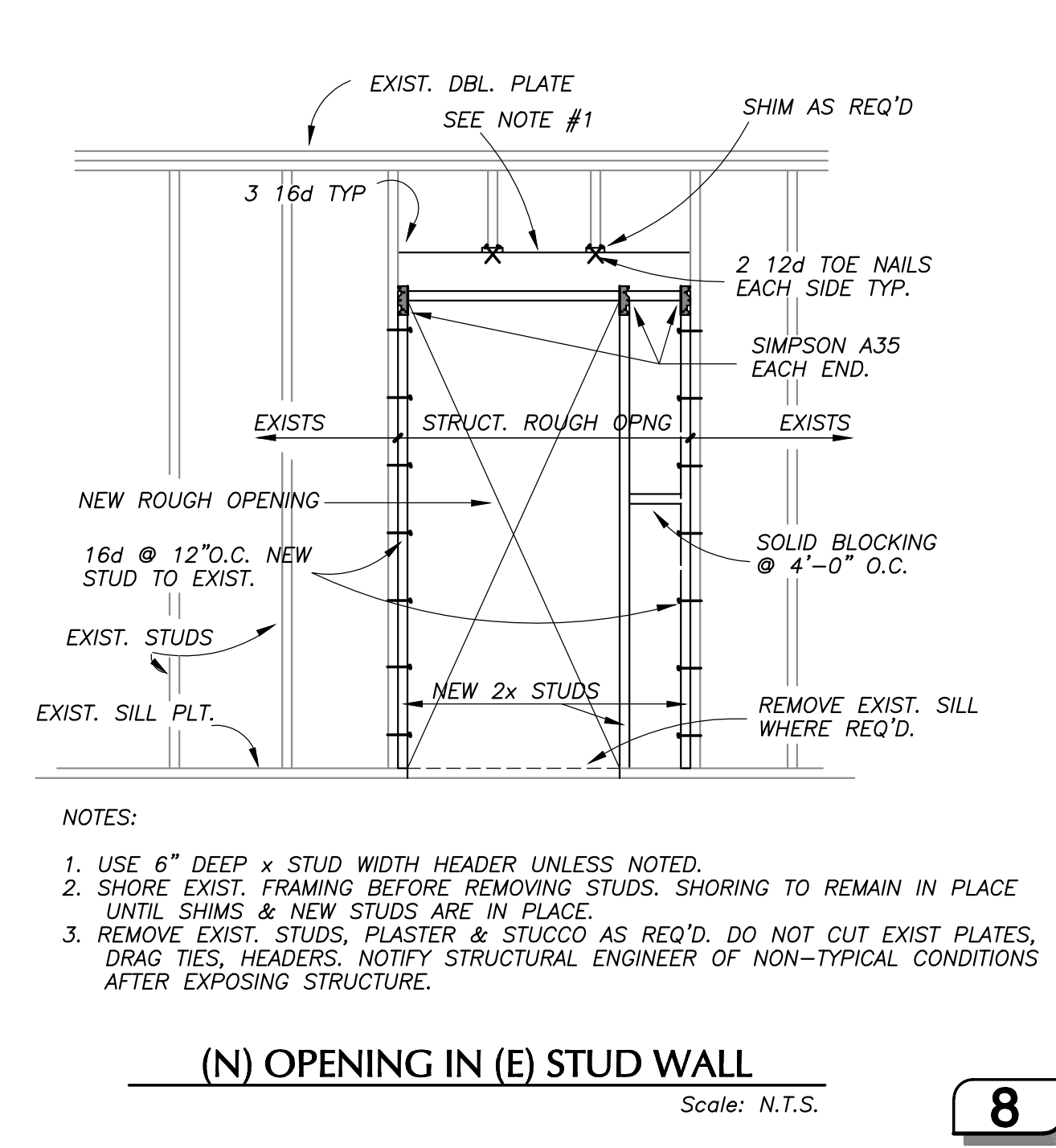
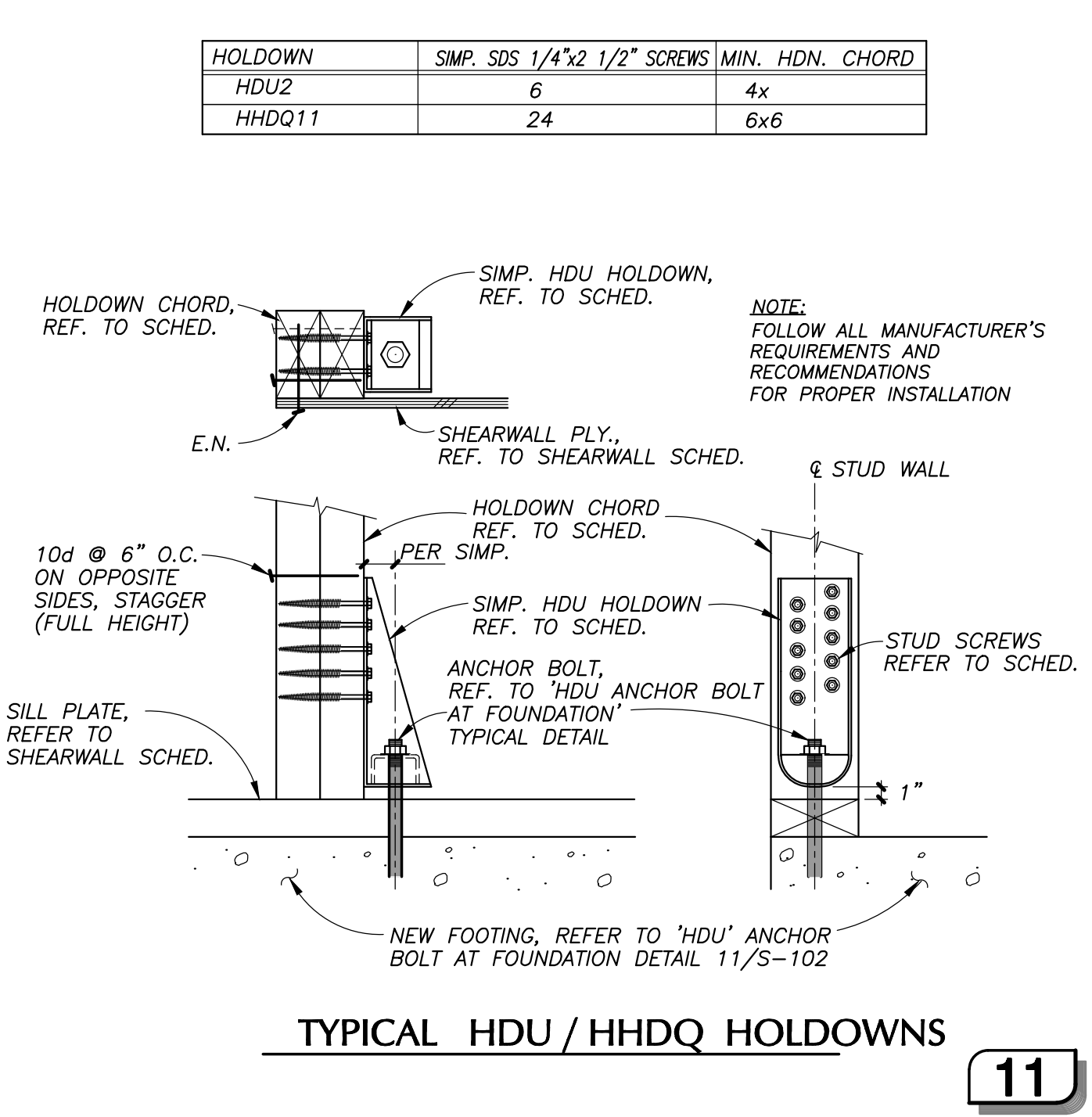
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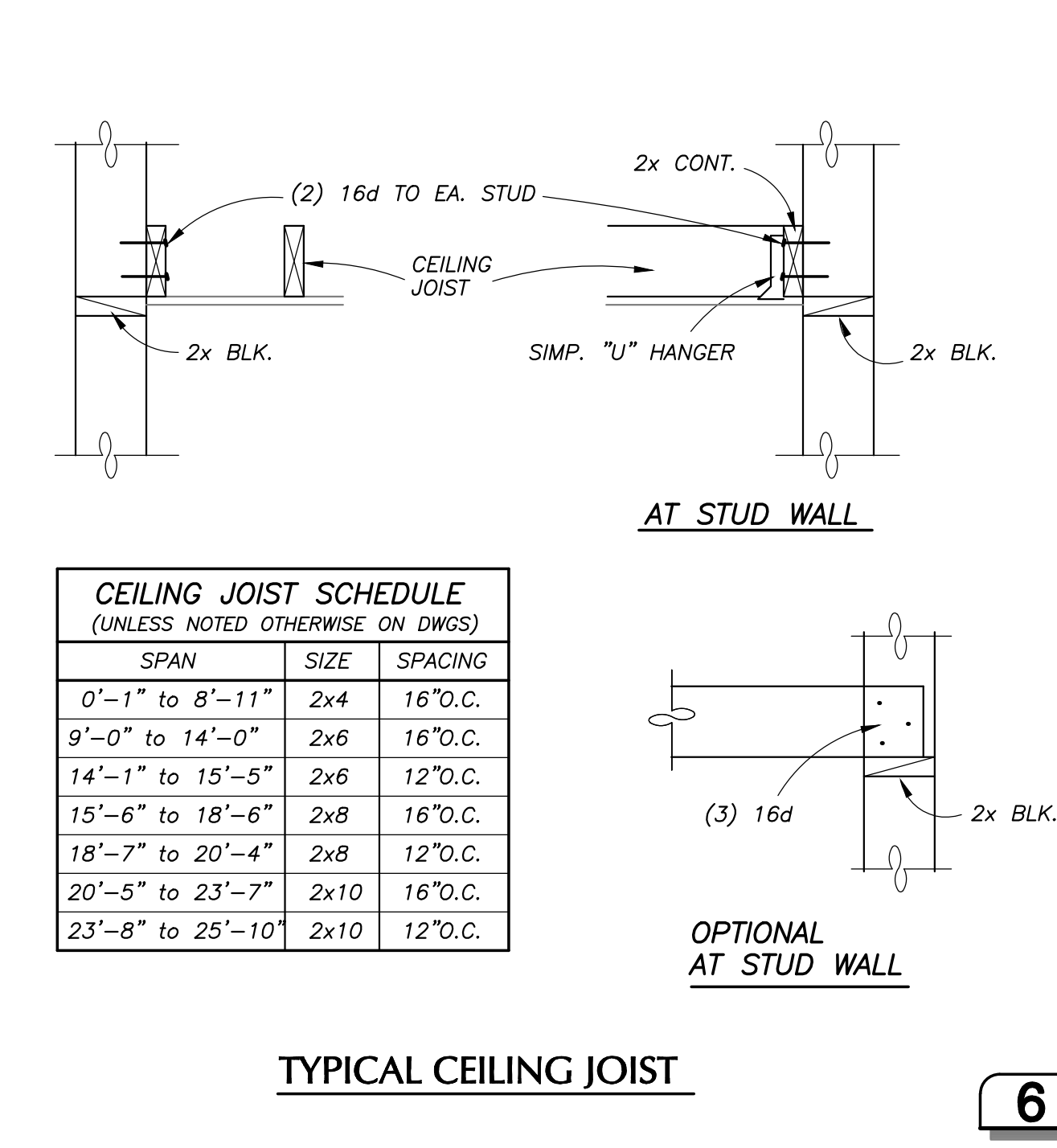
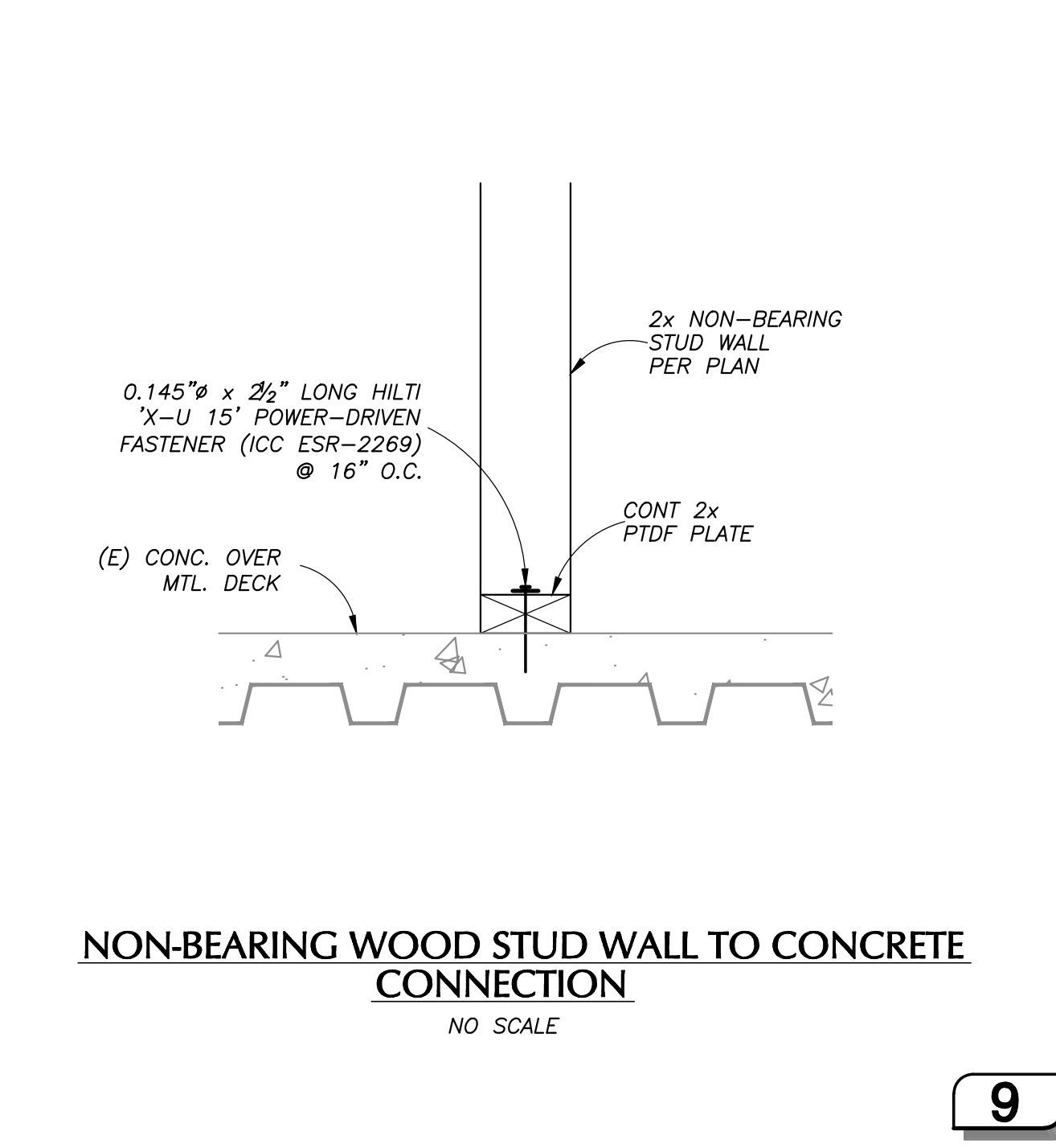
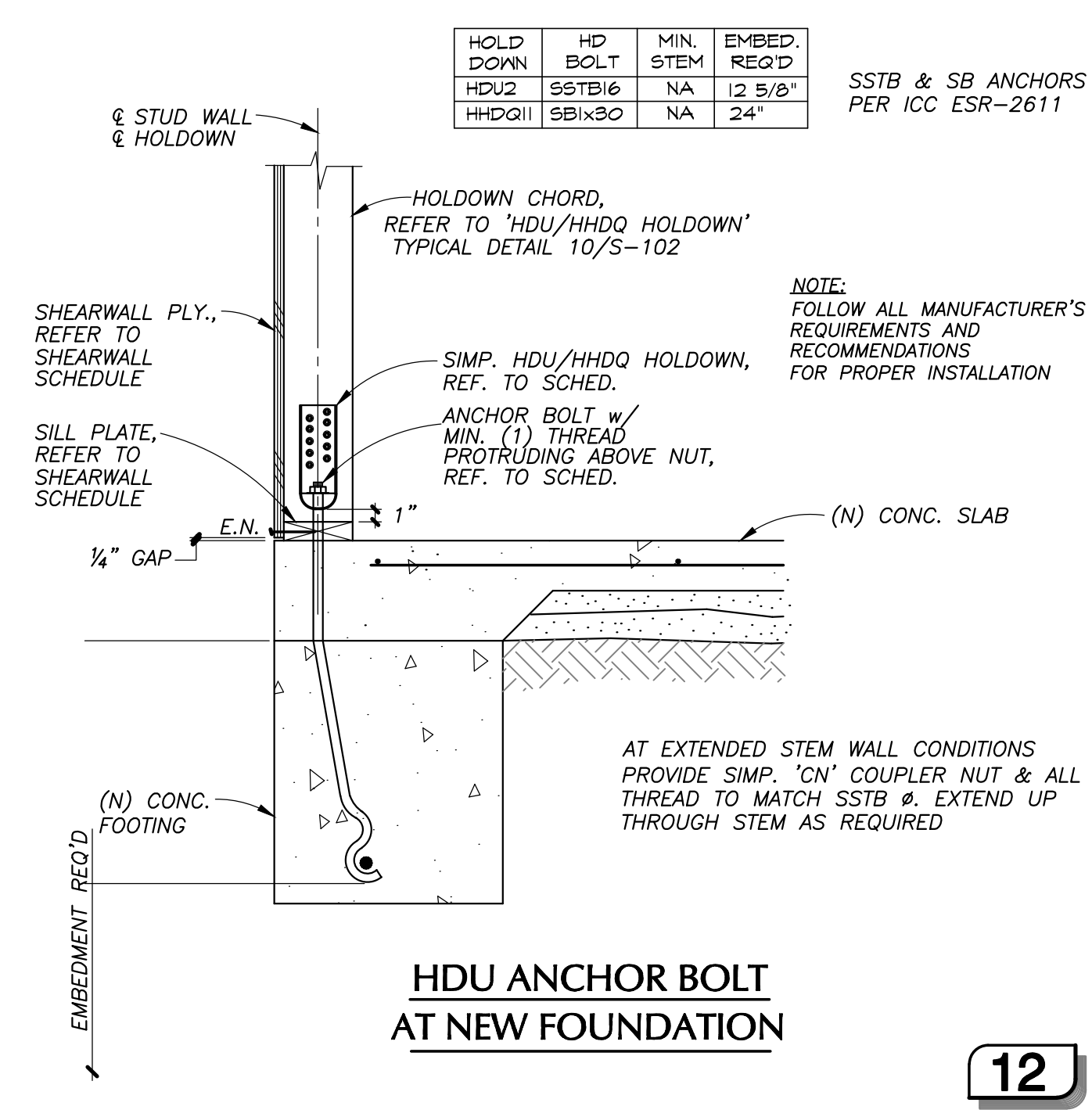
DATE: NOVEMBER 2, 2018 SHEET ____ OF ____



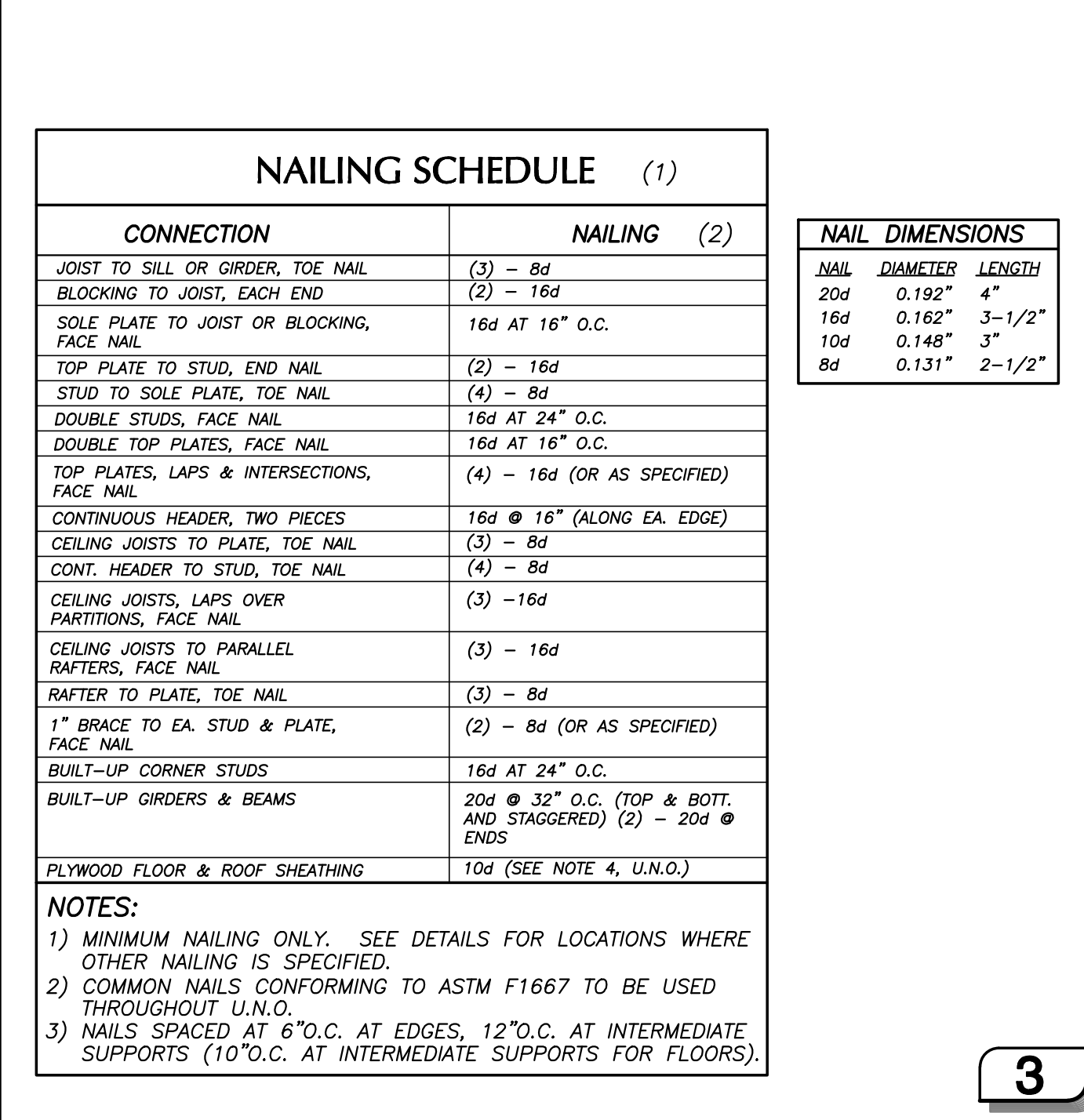
The details on the S-10X sheets are "typical" details which are to be used by the contractor where these various general conditions exist. These details are not necessarily referenced anywhere else in this set of construction documents. Prior to starting work, the contractor is to confirm with the Engineer that these details are properly interpreted and applied to the appropriate conditions.



HEADER SCHEDULE		
SPAN	HEADER	d (NOMINAL)
TO - 4'-11"	WIDTH OF STUD x 4	
5'-0" - 6'-11"	WIDTH OF STUD x 6	
7'-0" - 9'-5"	WIDTH OF STUD x 8	
9'-6" - 12'-0"	WIDTH OF STUD x 10	
FOR SPANS GREATER THAN 12'-0" HEADER SHALL BE AS DIRECTED BY STRUCTURAL ENGINEER.		



CEILING JOIST SCHEDULE (UNLESS NOTED OTHERWISE ON DWGS)		
SPAN	SIZE	SPACING
0'-1" to 8'-11"	2x4	16" O.C.
9'-0" to 14'-0"	2x6	16" O.C.
14'-1" to 15'-5"	2x6	12" O.C.
15'-6" to 18'-6"	2x8	16" O.C.
18'-7" to 20'-4"	2x8	12" O.C.
20'-5" to 23'-7"	2x10	16" O.C.
23'-8" to 25'-10"	2x10	12" O.C.



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STATE OF CALIFORNIA
No. 37-19
EXPIRES 3/31/19

REGISTERED PROFESSIONAL ENGINEER
STATE OF CALIFORNIA
No. 4981
EXPIRES 9/30/19
STRUCTURAL

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SHEET TITLE

TYPICAL DETAILS

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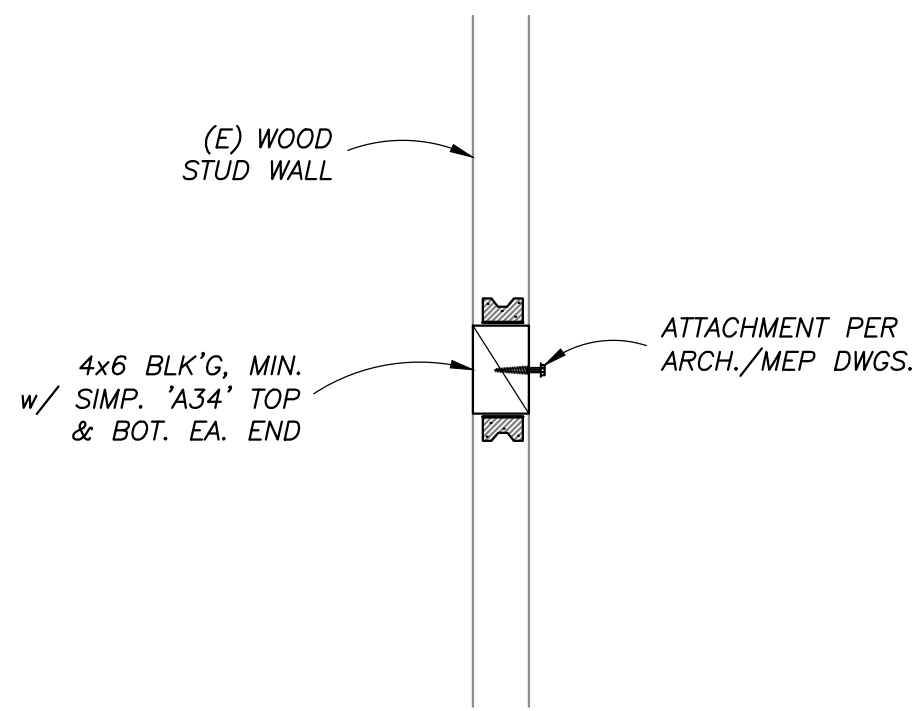
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S-101

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

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 PLOT DATE: Nov 02, 2018 - 11:27 AM
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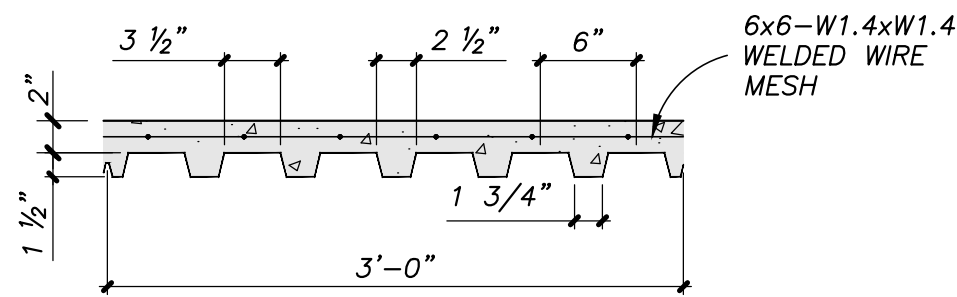
TYP. WOOD BACKING DETAIL

7

Section Properties for PLB™-36 or HSB®-36 Roof Decks

Deck Gage	Weight		Properties per ft of Width			Allowable Reactions per ft of Width (lb)			
	Galv psf	Painted psf	I in ⁴	+S in ³	-S in ³	End Bearing		Interior Bearing	
22	1.9	1.8	0.175	0.187	0.198	710	618	884	1185
20	2.3	2.2	0.216	0.235	0.246	990	1135	1225	1665
18	2.9	2.8	0.302	0.322	0.335	1362	1585	2028	2929
16	3.5	3.4	0.377	0.411	0.417	2492	2824	3010	4278

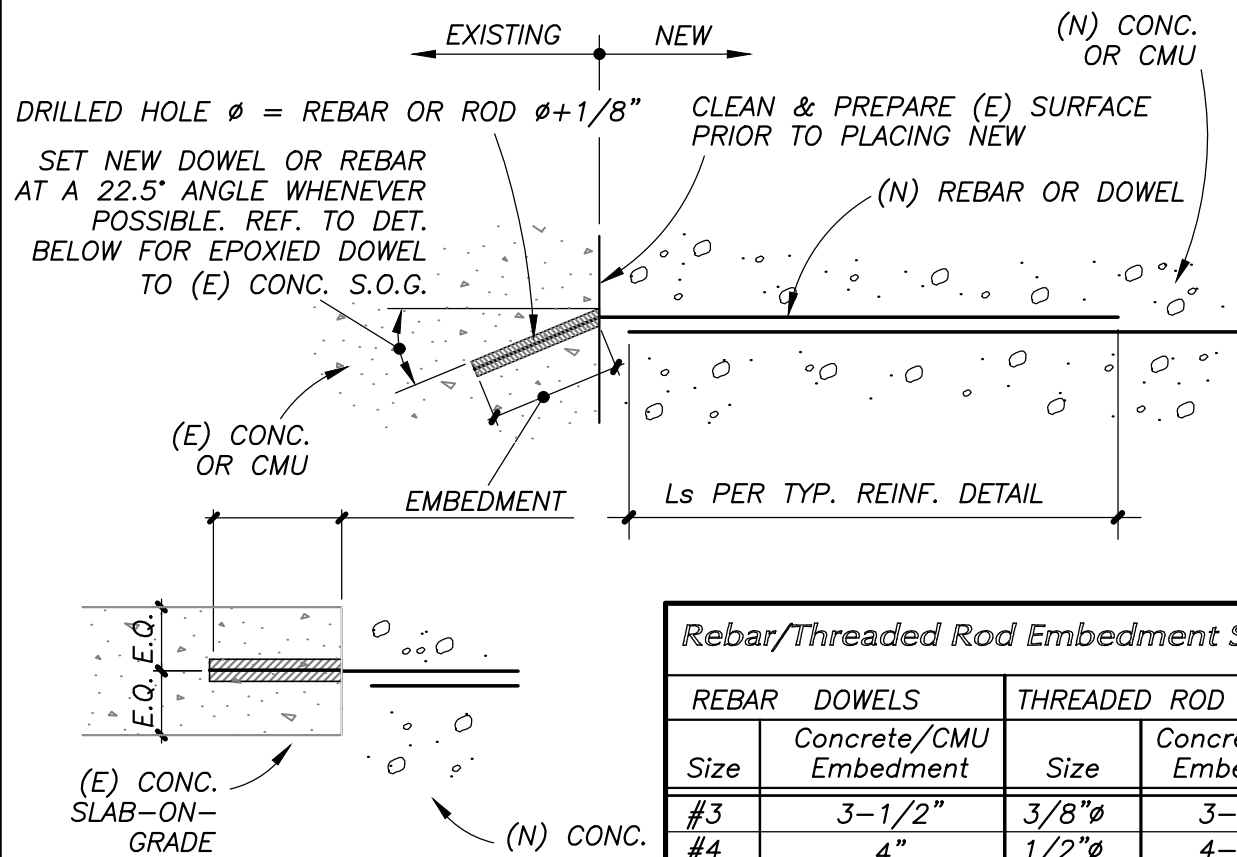
F_y = 22.8 ksi, F_y = 38 ksi



CONCRETE OVER VERCO TYPE 'PLB-36' MTL. DECK

NO SCALE

4



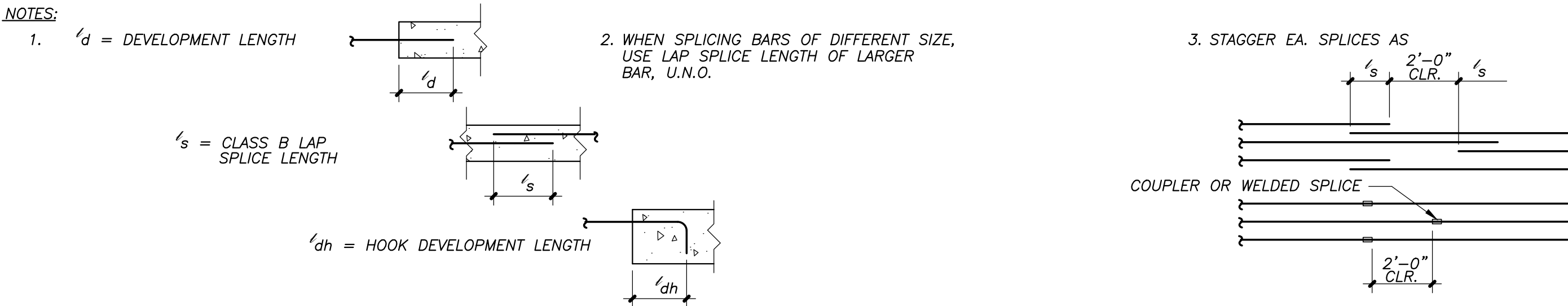
EPOXY SCHEDULE NOTES:
1. Use high strength, high bond, non-shrink concrete epoxy adhesive. Refer to Structural General Notes for approved manufacturer.
2. Special inspection is required for installation of rebar dowels & threaded rods.
3. Follow all manufacturer's requirements and recommendations for proper installation.
4. Clear out all dust and fragments from drilled holes with oil-free compressed air before placing epoxy.
5. Embedments in Table are only to be used where specific embedments are not called out elsewhere.

TYP. REBAR/THRD. ROD EPOXIED DOWEL INTO EXISTING

1

REBAR		DOWELS		THREADED ROD DOWELS	
Size	Concrete/CMU Embedment	Size	Concrete/CMU Embedment	Size	Concrete/CMU Embedment
#3	3-1/2"	3/8"	3-1/2"	3/8"	3-1/2"
#4	4"	1/2"	4-1/4"	1/2"	4-1/4"
#5	5"	5/8"	5"	5/8"	5"
#6	7"	3/4"	6-5/8"	3/4"	6-5/8"

CONCRETE REINFORCING DEVELOPMENT & SPLICE LENGTHS (IN INCHES) - PER ACI 318-14																
BAR LOCATION	CONCRETE		BAR SIZE													
	TYPE	STRENGTH	BAR SIZE													
			#3	#4	#5	#6	#7	#8	#9	#10	#11	#12	#13	#14	#15	#16
WALL VERT. REINF. FOUNDATION REINF. SLAB-ON-GRADE REINF. CONC. SLAB O/ MTL. DECK	NORMAL	f'c = 3ksi	17	22	29	36	43	51	59	67	75	83	91	99	107	115
FTG. TOP REINF. STEM WALL HORIZ. REINF. (ψt=1.3)	NORMAL	f'c = 3ksi	22	28	36	43	51	59	67	75	83	91	99	107	115	123



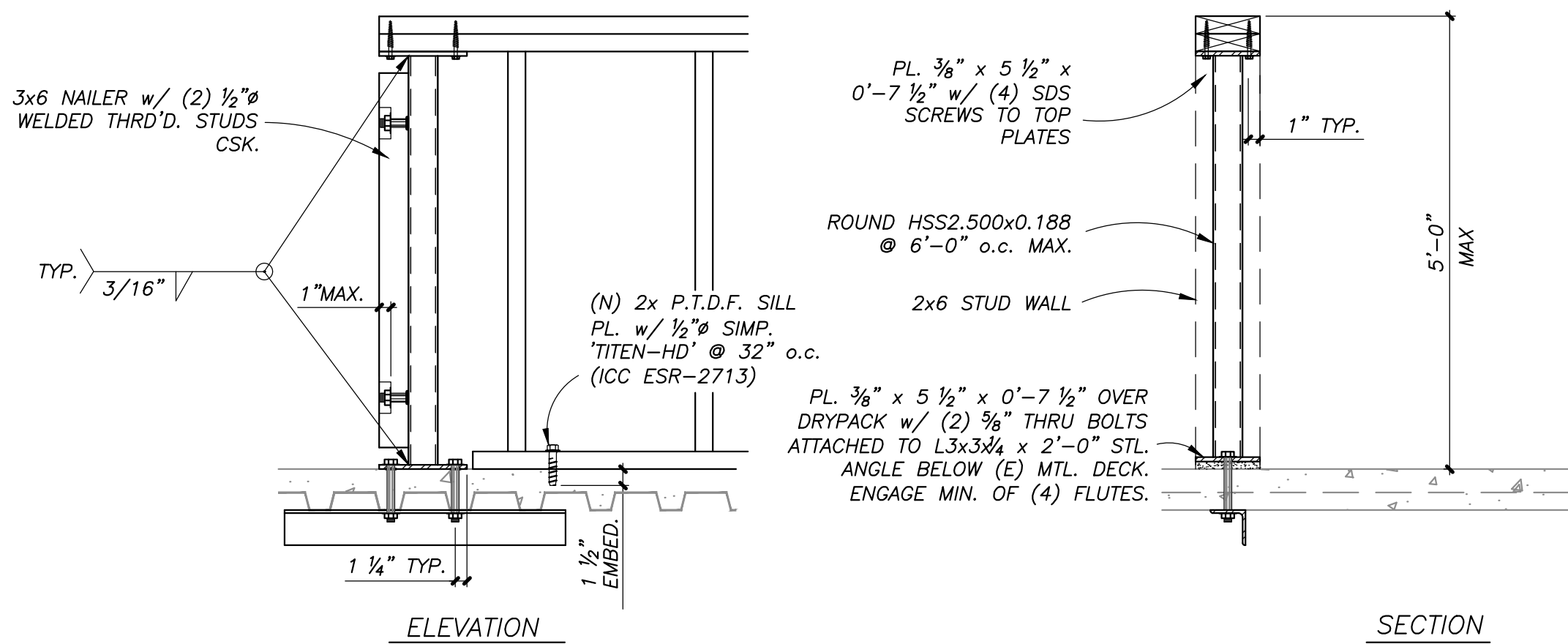
REINFORCING DEVELOPMENT & SPLICE LENGTHS

NO SCALE

2

11

8



TYPICAL ROUND HSS COLUMN @ LOW WALLS

Scale: 1" = 1'-0"

3

12

9



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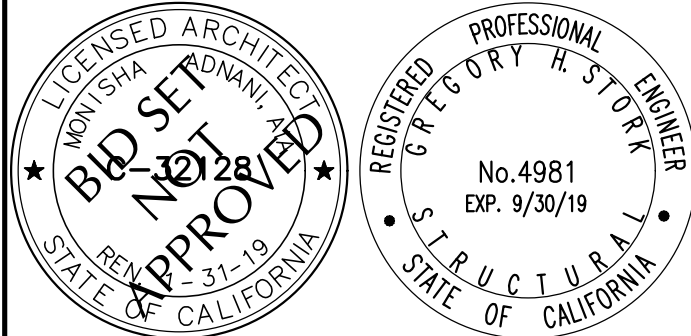
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TYPICAL DETAILS

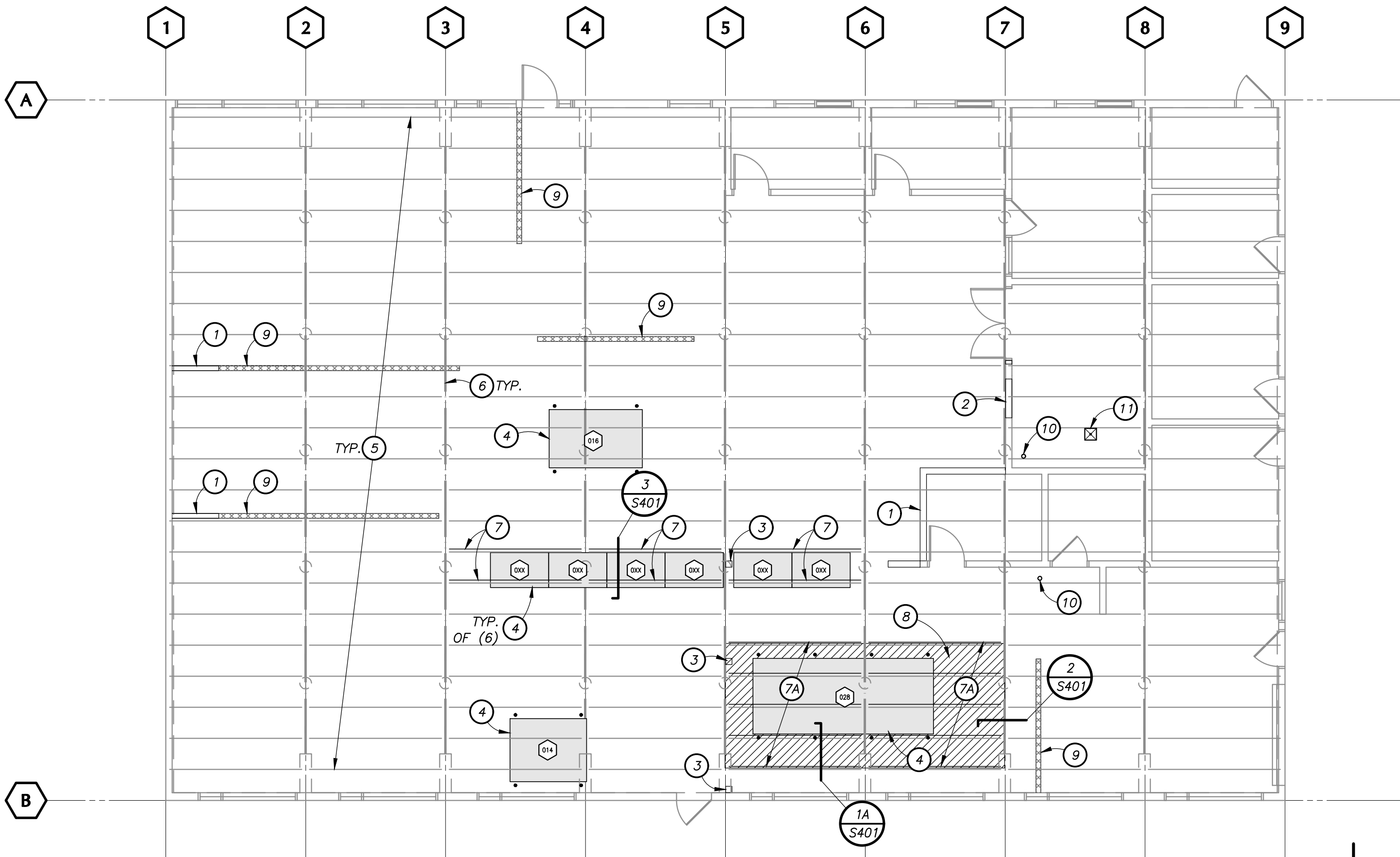
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SHEET NO.

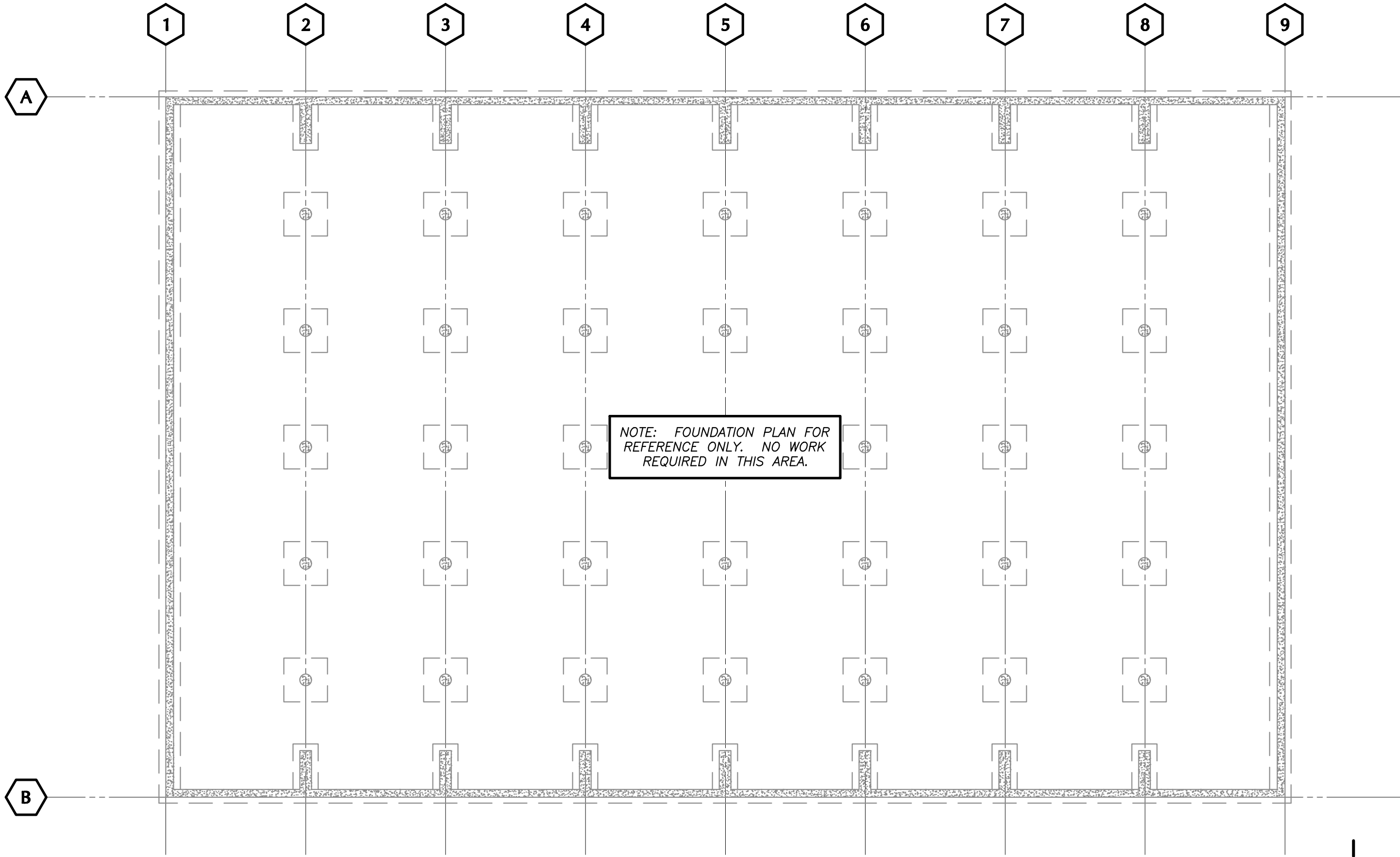
S-102

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____



FLOOR FRAMING PLAN

SCALE: 1/8" = 1'-0"



FOUNDATION PLAN

SCALE: 1/8" = 1'-0"

KEYED NOTES :

- 1 (N) INTERIOR NON-BEARING WALL
2 (N) INFILL IN (E) INTERIOR NON-BEARING WALL
3 (N) POST w/ (N) HEADER ABOVE IN (E) NON-BEARING STUD WALL
4 (N) EQUIPMENT w/ BASE ANCHORAGE PER SCHEDULE BELOW
5 (E) C6x8.2 STL. JOISTS @ 32" o.c.
6 (E) DBL. C10x15.3 STL. BEAM, BACK-TO-BACK
7 (N) C6x8.2 STL. JOIST, BACK-TO-BACK w/ (E) C6 JOIST PER DET. 1/S-401, SIM. NOTCH FLANGE AS NEEDED AND WELD WEB TO WEB OF (E) C10 STL. BEAM. WHERE CONC. AND METAL DECK REPLACEMENT IS REQ'D AT 7A, PROVIDED WELDED STUDS AT EA. JOIST PER DET. 1A/S-401.
8 (N) CONC. OVER METAL DECK PER TYP. DET. 4/S-102 @ (E) FLR. OPN'G.
9 (N) PARTIAL HT. STUD WALL PER TYP. DET. 3/S-102.
10 CORE (N) OPENING IN (E) FLOOR. NO REINF. REQ'D. REF. TO ARCH./ PLUMBING DWGS. FOR EXACT LOCATION. DO NOT CUT (E) FLOOR JOIST.
11 (N) 12" SQ. OPENING IN (E) FLOOR. NO REINF. REQ'D. REF. TO ARCH./ PLUMBING DWGS. FOR EXACT LOCATION. DO NOT CUT (E) FLOOR JOIST.

EQUIPMENT SCHEDULE :

ITEM TAG NO.	EQUIPMENT TYPE	MANUFACTURER	MODEL NO.	WEIGHT (LBS)	ANCHORAGE DETAIL
014	PAPER CUTTER	PERFECTA	76TS	3,640	4/S-401
016	PRINTING PRESS	RYOBI	340HA-2	2,932	4/S-401
028	PRINTING PRESS	RYOBI	524GE	15,056	4/S-401
048	STORAGE RACK	-	-	1,500	3/S-401

LEGEND

- INDICATES (E) FOOTING
--- INDICATES (E) CONC. STEM WALL TO REMAIN
--- INDICATES (N) WOOD NON-BEARING STUD WALL
--- INDICATES (N) PARTIAL HT. WOOD STUD WALL
• INDICATES ANCHORAGE POINT OF (N) EQUIP.

PMSM
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19.6
ARCHITECTS

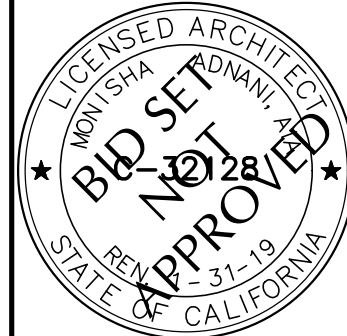
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ARCHITECT STAMP



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AGENCY APPROVAL

REVISIONS

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PROJECT OWNER & TITLE

SAN BERNARDINO
COMMUNITY COLLEGE DIST.
PRINT SHOP T.I. AT
CRAFTON HILLS
COLLEGE BL 14
11711 SAND CANYON ROAD
YUCAIPA, CA 92399

SHEET TITLE

FLOOR FRAMING /
FOUNDATION
PLANS

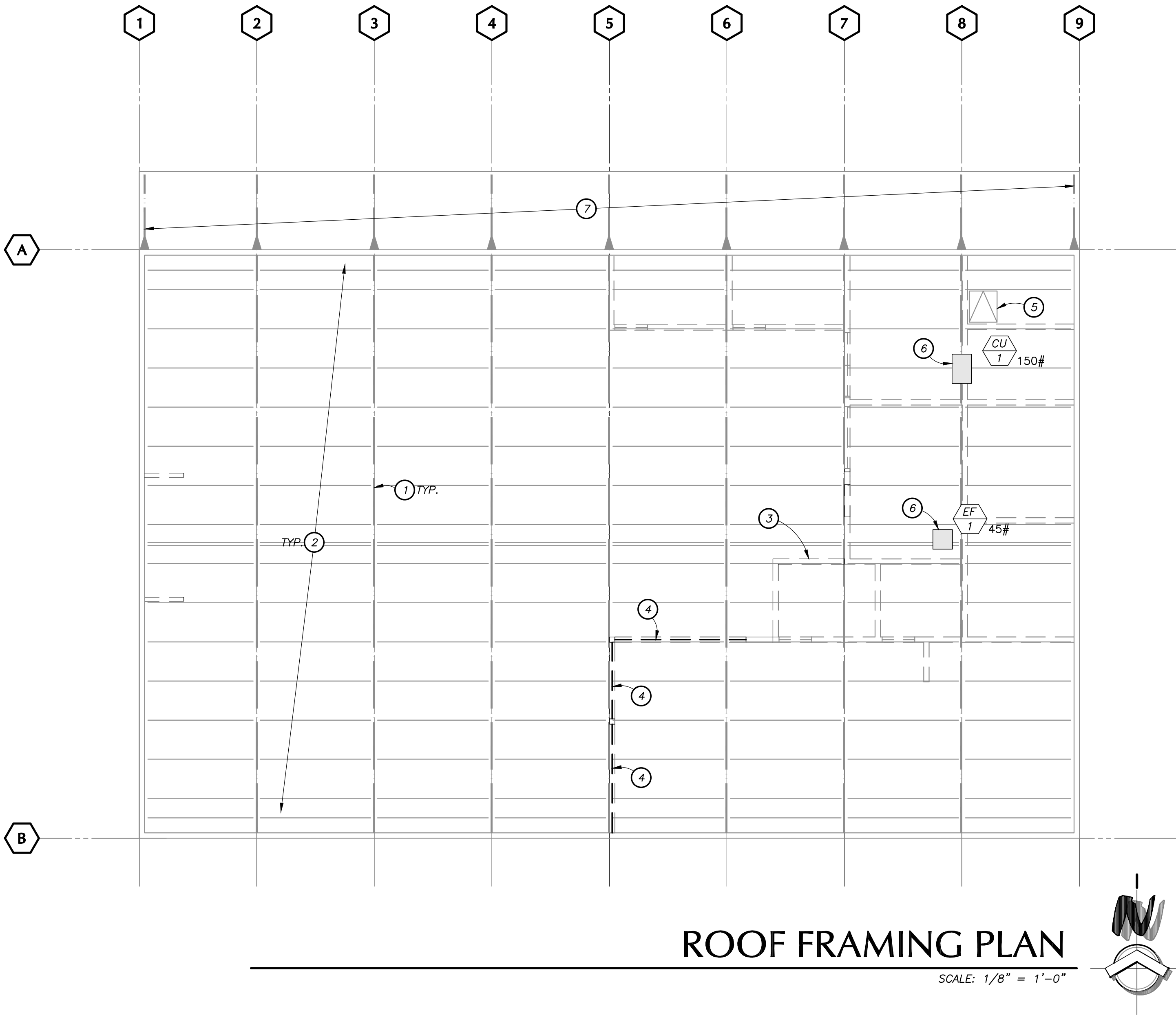
DRAWN BY: GHS

JOB NUMBER: 18052

SHEET NO.

S-201

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____



ROOF FRAMING PLAN

SCALE: 1/8" = 1'-0"

KEYED NOTES :

- 1 (E) DBL. STL. ROOF TRUSS @12'-0" o.c.
- 2 (E) 6" x 14 ga. STEEL ROOF JOISTS @ 48" o.c.
- 3 (N) NON-BEARING WOOD STUD WALL BELOW PER TYP. DETS.
- 4 (N) WOOD HEADER IN NON-BEARING WOOD STUD WALL BELOW PER TYP. DETS.
- 5 (E) ROOF HATCH TO REMAIN
- 6 (N) ROOFTOP MECH. UNIT. REF. TO MECH. DWGS.
- 7 (E) CANOPY FRAMING TO REMAIN

ROOF EQUIPMENT SCHEDULE :

ITEM TAG NO.	UNIT TYPE	MANUFACTURER	MODEL NO.	WEIGHT (LBS)	ANCHORAGE DETAIL
CU-1	AIR CONDITIONING	PER MECH. DWGS.		150	2/A-202
EF-1	EXHAUST FAN	PER MECH. DWGS.		45	3/A-202

LEGEND

- == == == == INDICATES (N) WOOD NON-BEARING STUD WALL BELOW
- == == == == INDICATES (E) WOOD NON-BEARING STUD WALL BELOW



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SHEET TITLE

ROOF FRAMING
PLAN

DRAWN BY: GHS

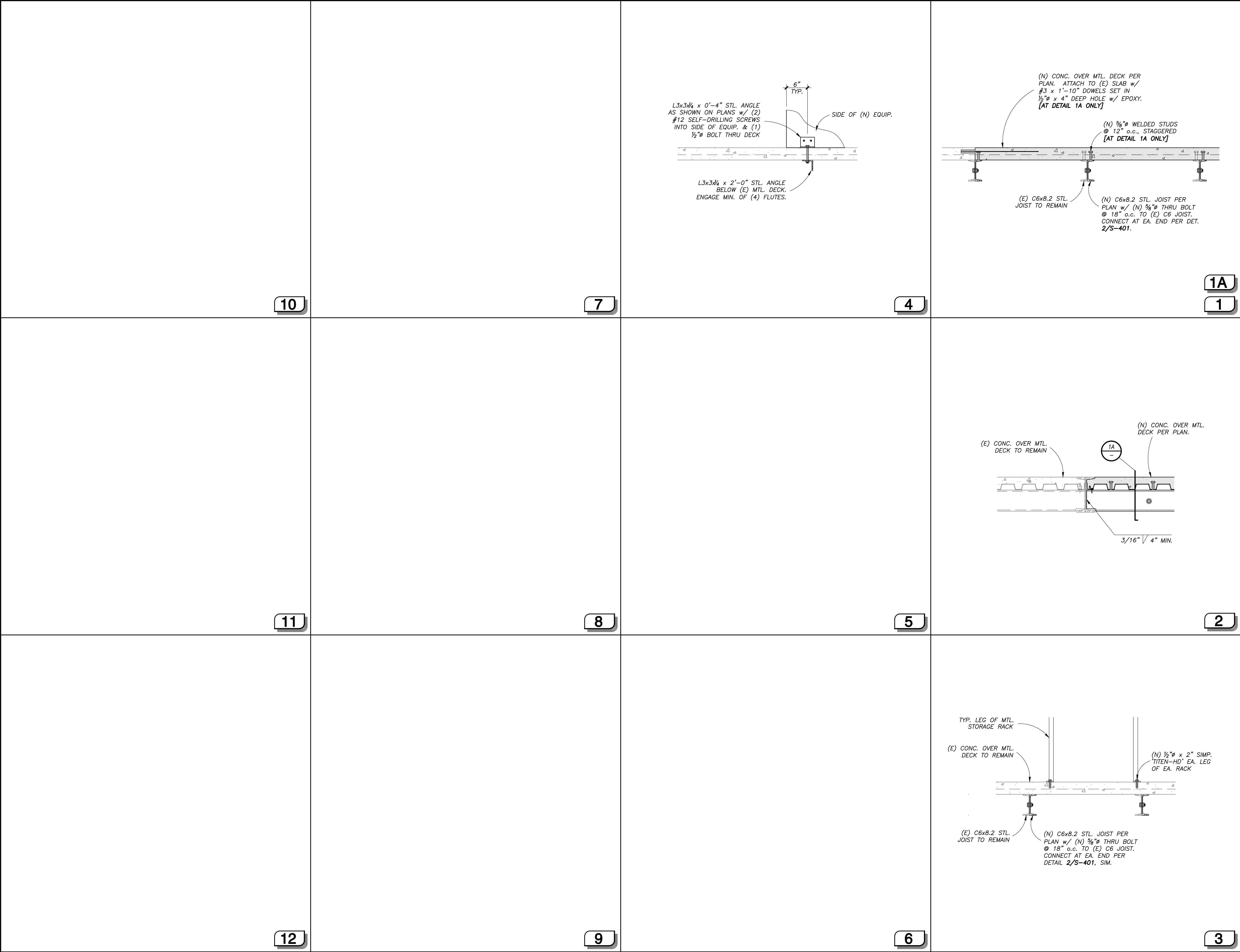
JOB NUMBER: 18052

SHEET NO.

S-202

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

PLOT BY: GREG
PLOT DATE: Nov 02, 2018 - 11:27 AM
DRAWING MADE: P:\PROJECTS\1\SWA PROJECTS\18052 - CJC Print Shop T1\STRUCTURAL\18052_S1_STRUCT DET.SWG



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LICENSED ARCHITECT
DAVID L. STORK
No. 4981
EXP. 9/30/19
STATE OF CALIFORNIA

CONSULTANT STAMP
REGISTERED PROFESSIONAL ENGINEER
GREGORY H. STORK
No. 4981
EXP. 9/30/19
STATE OF CALIFORNIA

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SHEET TITLE
**STRUCTURAL
DETAILS**

DRAWN BY: GHS JOB NUMBER: 18052

SHEET NO.
S-401
DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

GENERAL LEGEND

SYMBOL	DESCRIPTION
	NOTE CALLOUT
	DETAIL CALLOUT - NUMBER ON TOP DENOTES DETAIL NUMBER - NUMBER ON BOTTOM DENOTES SHEET DETAIL IS SHOWN
	MECHANICAL EQUIPMENT CALLOUT. SEE MECHANICAL PLANS FOR EXACT LOCATION AND REQUIREMENTS
	SECTION CALLOUT
	POINT OF CONNECTION
	POINT OF DISCONNECTION
	NEW LINEWORK
	EXISTING LINEWORK
	DEMOLITION LINEWORK
	DIRECTION OF FLOW

DUCTWORK LEGEND

SYMBOL	DESCRIPTION
	SHEET METAL DUCT
	HIDDEN SHEET METAL DUCT
	STANDARD BRANCH FOR SUPPLY AND RETURN
	ROUND ELBOW DOWN
	ROUND ELBOW UP
	RECTANGULAR TO ROUND TRANSITION
	FLEXIBLE DUCT
	SUPPLY DIFFUSER: 2-WAY/3-WAY/4-WAY
	GRILLE: RETURN/EXHAUST
	SUPPLY AIR DUCT SECTION
	RETURN AIR DUCT SECTION
	EXHAUST AIR DUCT SECTION

CONTROL LEGEND

SYMBOLS	DESCRIPTION
	DDC PHYSICAL POINT
	SENSOR
	SWITCH
	COMMUNICATION GATEWAY CONNECTION TO DDC
	ELECTRONICALLY COMMUTATED MOTOR
	VARIABLE FREQUENCY DRIVE
	ELECTRONIC 3-WAY VALVE
	ELECTRONIC 2-WAY VALVE
	ELECTRONIC BUTTERFLY VALVE
	DAMPER WITH ACTUATOR, OPPOSED BLADE
	DAMPER WITH ACTUATOR, PARALLEL BLADE
	COOLING COIL
	HEATING COIL
	AIR FILTER BANK
	AVERAGING AIR TEMPERATURE SENSOR
	FIELD CONTROL WIRING
	FIELD POWER WIRING

ABBREVIATIONS

ABBREVIATIO N	DESCRIPTION	ABBREVIATIO N	DESCRIPTION
AAV	AUTOMATIC AIR VENT	HP	HORSEPOWER
AFF	ABOVE FINISHED FLOOR	HT	HEIGHT
AHU	AIR HANDLING UNIT	HZ	HERTZ
AL	ALUMINUM	ID	INSIDE DIAMETER
AP	ACCESS PANEL	IN	INCHES
APD	AIRSIDE PRESSURE DROP	KW	KILOWATTS
BD	BLOWDOWN	LAT	LEAVING AIR TEMPERATURE
BDD	BACK DRAFT DAMPER	LBS	POUNDS
BFC	BELOW FINISHED CEILING	LF	LINEAR FEET
BFP	BACK FLOW PREVENTER	LWT	LEAVING WATER TEMPERATURE
BHP	BRAKE HORSEPOWER	MAX	MAXIMUM
BLDG	BUILDING	MBH	THOUSAND BTU PER HOUR
BOB	BOTTOM OF BEAM	MC	MECHANICAL CONTRACTOR
BOP	BOTTOM OF PIPE	MCA	MINIMUM CIRCUIT AMPS
BTU	BRITISH THERMAL UNIT	MH	MANHOLE
CFM	CUBIC FEET PER MINUTE	MIN	MINIMUM
CHWR	CHILLED WATER RETURN	MOC	MAXIMUM OVERLOAD CIRCUIT PROTECTION
CHWS	CHILLED WATER SUPPLY	NFA	NET FREE AREA
CI	CAST IRON	NIC	NOT IN CONTRACT
CL	CENTER LINE	NPSHR	NET POSITIVE SUCTION HEAD REQUIRED
CP	CONDENSATE PUMP	OAT	OUTSIDE AIR TEMPERATURE
CT	COOLING TOWER	OB	OPPOSED BLADE DAMPER
CU	CONDENSING UNIT	OC	ON CENTER
CV	CONSTANT VOLUME BOX	OD	OUTSIDE DIAMETER
CWR	CONDENSER WATER RETURN	OA	OUTSIDE AIR
CWS	CONDENSER WATER SUPPLY	PD	PRESSURE DROP
CWFR	CONDENSER WATER FILTER RETURN	PERF	PERFORATED
CWFS	CONDENSER WATER FILTER SUPPLY	PH	PHASE
DB	DRY BULB	POD	POINT OF DISCONNECT
DEG	DEGREES	PR	PRESSURE RELIEF
DIA	DIAMETER	PRV	PRESSURE REDUCING VALVE
DL	DOOR LOUVER	PSID	DIFFERENTIAL
DN	DOWN	PSIG	POUNDS PER SQUARE INCH GAUGE
DX	DIRECT EXPANSION	PVC	POLYVINYL CHLORIDE
(E)	EXISTING	RA	RETURN AIR
EA	EACH	RF	RETURN FAN
EAT	ENTERING AIR TEMPERATURE	RLA	RATED LOAD AMPS
EC	ELECTRICAL CONTRACTOR	RPM	REVOLUTIONS PER MINUTE
EFF	EFFICIENCY	SA	SUPPLY AIR
EL	ELEVATION	SF	SUPPLY FAN
ESP	EXTERNAL STATIC PRESSURE	SPEC	SPECIFICATION
EWT	ENTERING WATER TEMPERATURE	SS	STAINLESS STEEL
°F	DEGREES FAHRENHEIT	STD	STANDARD
FD	FIRE DAMPER	TAD	TRANSFER AIR DUCT
FG	FILTER GRILLE	TDH	TOTAL DYNAMIC HEAD
FLA	FULL LOAD AMPS	TEFC	TOTALLY ENCLOSED FAN COOLED
FLR	FLOOR	TSP	TOTAL STATIC PRESSURE
FOB	FLAT ON BOTTOM	TYP	TYPICAL
FOT	FLAT ON TOP	UC	UNDERCUT
FPI	FINS PER INCH	UTR	UP THROUGH ROOF
FPM	FEET PER MINUTE	TYP	TYPICAL
FSD	FIRE SMOKE DAMPER	V	VOLTS
FT	FEET OR FOOT	VAV	VARIABLE AIR VOLUME
GA	GAUGE	VD	VOLUME DAMPER
GALV	GALVANIZED	VFD	VARIABLE FREQUENCY DRIVE
GC	GENERAL CONTRACTOR	VTR	VENT THRU ROOF
GPH	GALLONS PER HOUR	W/	WITH
GPM	GALLONS PER MINUTE	W/O	WITHOUT
HB	HOSE BIBB	WB	WET BULB
HD	HEAD	WC	WATER COLUMN
HHWR	HEATING HOT WATER RETURN	WG	WATER GAUGE
HHWS	HEATING HOT WATER SUPPLY	WPD	WATER PRESSURE DROP
HP	HEAT PUMP	WT	WEIGHT

IN THE EVENT ABBREVIATIONS NOT MENTIONED HEREIN ARE USED, REFERENCE WILL BE MADE TO ANSI Y1.1, MILITARY STANDARD ABBREVIATIONS, AND OTHER STANDARD INDUSTRY CONVENTIONS.

CONTROL ABBREVIATIONS

ABBREVIATIO N	DESCRIPTION	ABBREVIATIO N	DESCRIPTION
A	ALARM	PS	PRESSURE SWITCH
AFMS	AIRFLOW MONITORING STATION	PT	PRESSURE TRANSMITTER
AI	ANALOG INPUT	RH	RELATIVE HUMIDITY
AO	ANALOG OUTPUT	S	STATUS
CS	CURRENT SWITCH	SC	SPEED CONTROL
DI	DIGITAL INPUT	SI	SPEED INDICATOR
DO	DIGITAL OUTPUT	SP	SETPOINT
DP	DIFFERENTIAL PRESSURE	SS	START/STOP
FS	FLOW SWITCH	T	TEMPERATURE
FM	FLOW METER	TI	TEMPERATURE INDICATOR
HQA	HANDS-OFF-AUTO	VA	DAMPER/VALVE ACTUATOR
KW	KILOWATTS	VP	VELOCITY PRESSURE
LA	LEVEL ALARM	VSH	VIBRATION SWITCH
MOD	MOTOR OPERATED DAMPER	ZC	CLOSED END SWITCH
NC	NORMALLY CLOSED	ZI	POSITION INDICATOR
NO	NORMALLY OPEN	ZO	OPEN END SWITCH

IN THE EVENT ABBREVIATIONS NOT MENTIONED HEREIN ARE USED, REFERENCE WILL BE MADE TO ANSI Y1.1, MILITARY STANDARD ABBREVIATIONS, AND OTHER STANDARD INDUSTRY CONVENTIONS.

SHEET INDEX

SHEET	DESCRIPTION
M-001	GENERAL NOTES, LEGEND, AND SHEET INDEX
M-002	SCHEDULES
M-201	FLOOR PLAN
M-202	ROOF PLAN
M-501	CONTROLS
M-601	DETAILS
M-602	DETAILS
M-701	TITLE 24 COMPLIANCE FORMS

GENERAL NOTES

1.	ALL WORK SHALL COMPLY WITH THE 2016 EDITIONS OF THE CALIFORNIA BUILDING, MECHANICAL, PLUMBING, AND OTHER APPLICABLE FEDERAL, STATE, OR LOCAL CODES AS ADOPTED AND ENFORCED BY THE LOCAL JURISDICTION. IN CASE THE PLANS SHOW MORE STRINGENT REQUIREMENTS, THE PLANS SHALL GOVERN THE DESIGN, YET NOTHING ON THE DESIGN DOCUMENTS SHALL BE INTERPRETED AS AUTHORITY TO VIOLATE CODE(S) OR REGULATION(S).
2.	SUBMISSION OF BID IN CONNECTION WITH THIS WORK SHALL IMPLY THAT THE BIDDER HAS EXAMINED THE JOB SITE UNDER WHICH THE CONTRACTOR WILL BE OBLIGATED TO OPERATE UNDER THIS CONTRACT. NO EXTRA CHARGE WILL BE ALLOWED FOR FAILURE OF ANY BIDDER TO EXAMINE THE SITE PRIOR TO BID.
3.	WHERE USED, THE TERM "PROVIDE" SHALL MEAN "FURNISH AND INSTALL".
4.	IN THE EVENT OF A CONFLICT OR INCONSISTENCY BETWEEN ITEMS INDICATED ON DRAWINGS AND SPECIFICATIONS WITH CODE REQUIREMENTS, THE MORE STRINGENT STANDARD SHALL PREVAIL.
5.	CARE SHALL BE EXERCISED TO MINIMIZE ANY INCONVENIENCE OR DISTURBANCE TO OTHER AREAS OF THE BUILDING WHICH ARE TO REMAIN IN OPERATION. ISOLATE WORK AREAS TO KEEP DUST AND DIRT WITHIN THE CONSTRUCTION AREA.
6.	NO PIPING, EQUIPMENT, ETC. SHALL BE REMOVED, DISCONNECTED OR SHUT DOWN WITHOUT PRIOR REVIEW WITH THE OWNER TO CONFIRM THAT AREAS TO REMAIN IN OPERATION WILL NOT BE AFFECTED. IF ANY AREAS NOT WITHIN THE SCOPE OF WORK ARE AFFECTED BY ANY SHUTDOWN, REMOVAL OR DISCONNECTION, SUFFICIENT ADVANCE NOTICE MUST BE GIVEN TO THE OWNER INDICATING WHICH AREAS WILL BE AFFECTED, WHEN THE PROPOSED SHUTDOWN WILL OCCUR, AND FOR HOW LONG A PERIOD OF TIME.
7.	THE ARRANGEMENT OF EQUIPMENT AND PIPING SHOWN ON THE DRAWINGS IS BASED UPON INFORMATION AVAILABLE TO THE ENGINEER AT THE TIME OF DESIGN AND IS NOT INTENDED TO SHOW EXACT DIMENSIONS. THIS CONTRACTOR SHALL VERIFY ALL DIMENSIONS AT THE SITE MAKING FIELD MEASUREMENTS AND SHOP DRAWINGS NECESSARY FOR FABRICATION OR ERECTION OF HVAC SYSTEMS. MAKE ALLOWANCE FOR BEAMS, PIPES AND OTHER OBSTRUCTIONS IN BUILDING CONSTRUCTION. CHECK DRAWINGS SHOWING WORK OF OTHER TRADES AND CONSULT WITH THE OWNER'S REPRESENTATIVE IN THE EVENT OF POTENTIAL INTERFERENCE. SHOP DRAWINGS SHALL BE MINIMUM 1/4"=1'-0" SCALE, INDICATING FITTINGS, SIZES, WELDS AND CONFIGURATIONS AND SUBMITTED TO ENGINEER FOR REVIEW.
8.	THIS CONTRACTOR SHALL COORDINATE HIS WORK WITH ALL OTHER TRADES PRIOR TO FABRICATION, PURCHASE AND/OR INSTALLATION OF ALL WORK.
9.	EXISTING MATERIALS THAT ARE REMOVED SHALL NOT BE REUSED IN NEW SYSTEMS, EXCEPT WHERE INDICATED AS BEING RELOCATED.
10.	ALL EQUIPMENT SHALL BE INSTALLED IN STRICT COMPLIANCE WITH THE MANUFACTURER'S WRITTEN INSTRUCTIONS.
11.	THIS CONTRACTOR SHALL NOT BORE, NOTCH, CUT, OR PENETRATE INTO A STRUCTURAL MEMBER WITHOUT WRITTEN APPROVAL FROM A DESIGNATED STRUCTURAL ENGINEER AND THE OWNER.
12.	ALL PIPE ELBOWS SHALL BE LONG RADIUS UNLESS OTHERWISE SPECIFICALLY NOTED ON THE DRAWINGS.
13.	INSTALL MANUAL VOLUME DAMPERS WITHIN DUCT BRANCHES TO BALANCE AIRFLOW CFM. ON INSULATED DUCTS, MOUNT DAMPER REGULATOR ON 2" STAND-OFF BRACKET TO CLEAR INSULATION.
14.	ALL MATERIAL EXPOSED WITHIN RA PLENUMS SHALL BE NON-COMBUSTIBLE OR SHALL HAVE A FLAME SPREAD INDEX NOT GREATER THAN 25 AND SMOKE DEVELOPED INDEX NOT GREATER THAN 50. COMPLY WITH CMC-602.2.
15.	COORDINATE ACCESS TO EQUIPMENT WITH WORK OF OTHER TRADES. PROVIDE DUCT ACCESS DOORS AND CEILING ACCESS DOORS TO ALLOW ACCESS FOR FILTER CHANGEOUT, CONTROLS ACCESS AND ACCESS TO SERVICE/REMOVE COMPONENTS INCLUDING, BUT NOT LIMITED TO, FANS, PULLEYS, SHEAVES, BELTS, ETC.
16.	MECHANICAL COMPONENT ANCHORAGE NOTES: ALL MECHANICAL COMPONENTS SHALL BE ANCHORED AND INSTALLED PER THE DETAILS ON THE DSA APPROVED CONSTRUCTION DOCUMENTS. WHERE NO DETAIL IS INDICATED, THE FOLLOWING COMPONENTS SHALL BE ANCHORED OR BRACED TO MEET THE FORCE AND DISPLACEMENT REQUIREMENTS PRESCRIBED IN THE 2016 CBC, SECTIONS 1616A.1.18 THROUGH 1616A.1.26 AND ASCE 7-10 CHAPTER 13, 26 AND 30.

- ALL PERMANENT EQUIPMENT AND COMPONENTS.
- TEMPORARY OR MOVABLE EQUIPMENT THAT IS PERMANENTLY ATTACHED (E.G. HARD WIRED) TO THE BUILDING UTILITY SERVICES SUCH AS ELECTRICITY, GAS OR WATER.
- MOVABLE EQUIPMENT WHICH IS STATIONED IN ONE PLACE FOR MORE THAN 8 HOURS AND HEAVIER THAN 400 POUNDS ARE REQUIRED TO BE ANCHORED WITH TEMPORARY ATTACHMENTS.

THE FOLLOWING MECHANICAL COMPONENTS SHALL BE POSITIVELY ATTACHED TO THE STRUCTURE, BUT NEED NOT BE DETAILED ON THE PLANS. THESE COMPONENTS SHALL HAVE FLEXIBLE CONNECTIONS PROVIDED BETWEEN THE COMPONENT AND ASSOCIATED DUCTWORK, PIPING, AND CONDUIT:

- COMPONENTS WEIGHING LESS THAN 400 POUNDS AND HAVE A CENTER OF MASS LOCATED 4 FEET OR LESS ABOVE THE ADJACENT FLOOR OR ROOF LEVEL THAT DIRECTLY SUPPORT THE COMPONENT.
- COMPONENTS WEIGHING LESS THAN 20 POUNDS, OR IN THE CASE OF DISTRIBUTED SYSTEMS, LESS THAN 5 POUNDS PER FOOT, WHICH ARE SUSPENDED FROM A ROOF OR FLOOR OR HUNG FROM A WALL.

FOR THOSE ELEMENTS THAT DO NOT REQUIRE DETAILS ON THE APPROVED DRAWINGS, THE INSTALLATION SHALL BE SUBJECT TO THE APPROVAL OF THE DESIGN PROFESSIONAL IN GENERAL RESPONSIBLE CHARGE OR THE STRUCTURAL ENGINEER DELEGATED RESPONSIBILITY AND THE DSA DISTRICT STRUCTURAL ENGINEER. THE PROJECT INSPECTOR WILL VERIFY THAT ALL COMPONENTS AND EQUIPMENT HAVE BEEN ANCHORED IN ACCORDANCE WITH ABOVE REQUIREMENTS.

- PIPING AND DUCTWORK DISTRIBUTION SYSTEM BRACING NOTE:

PIPING AND DUCTWORK DISTRIBUTION SYSTEMS SHALL BE BRACED TO COMPLY WITH THE FORCES AND DISPLACEMENTS PRESCRIBED IN ASCE 7-10 SECTION 13.3 AS DEFINED IN ASCE 7-10 SECTION 13.6.8, 13.6.7, 13.6.5.6, AND 2016 CBC SECTIONS 1616A.1.23, 1616A.1.24, 1616A.1.25 AND 1616A.1.26.

THE METHOD OF SHOWING BRACING AND ATTACHMENTS TO THE STRUCTURE FOR THE IDENTIFIED DISTRIBUTION SYSTEM ARE AS NOTED BELOW. WHEN BRACING AND ATTACHMENTS ARE BASED ON A PREAPPROVED INSTALLATION GUIDE (E.G. SMAQNA OR OSHPD OPM), COPIES OF THE BRACING SYSTEM INSTALLATION GUIDE OR MANUAL SHALL BE AVAILABLE ON THE JOBSITE PRIOR TO THE START OF AND DURING THE HANGING AND BRACING OF THE DISTRIBUTION SYSTEMS. THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE TO SUPPORT THE HANGER AND BRACE LOADS.

MP X MD X PPX E X - OPTION 1: DETAILED ON THE APPROVED DRAWINGS WITH PROJECT SPECIFIC NOTES AND DETAILS.

- AIR FILTERS SHALL BE STATE FIRE MARSHAL APPROVED AND LISTED TYPE. PREFORMED FILTERS HAVING COMBUSTIBLE FRAMING SHALL BE TESTED AS A COMPLETE ASSEMBLY. AIR FILTERS IN ALL OCCUPANCIES SHALL BE CLASS 2 OR BETTER (AS SHOWN IN THE STATE FIRE MARSHAL LISTING). AIR FILTERS SHALL BE ACCESSIBLE FOR CLEANING OR REPLACEMENT PER CMC 304.0.



ARCHITECTS

196
ARCHITECTS

ARCHITECTS

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SHEET TITLE

GENERAL NOTES,
LEGEND AND
SHEET INDEX

DRAWN BY: MH/QP

JOB NUMBER: 18116.03

SHEET NO.

M-001

DATE: NOVEMBER 2, 2018 SHEET ____ OF

PACKAGED AIR CONDITIONING UNIT (EXISTING)

MARK	MANUFACTURER & MODEL	LOCATION	TYPE	SERVICE	SUPPLY FAN		COOLING			HEATING				ELECTRICAL					REFRIGERANT	MINIMUM OUTSIDE AIR CFM SETPOINT	NOTES
					AIRFLOW CFM	HP	TONS (NOMINAL)	AMBIENT °F	SEER	TYPE	INPUT MBH	OUTPUT MBH	TE □	VOLTAGE	PHASE	HZ	MCA	MOCP			
(E) BL 14 ACU 1	CARRIER 48GSN060	BUILDING 14 ROOF	ROOFTOP GAS/ELECTRIC	NORTH WALL OFFICES	2,000	-	5	105	10.0	NAT. GAS	74.9	60.0	80.1	208	3	60	31.1	45	R-22	-	1 3 4
(E) BL 14 ACU 2	CARRIER 48GSN036	BUILDING 14 ROOF	ROOFTOP GAS/ELECTRIC	BREAK AREA 107	1,270	-	3	105	10.0	NAT. GAS	49.9	40.0	80.1	208	3	60	18.8	25	R-22	150	1 2 3 4
(E) BL 14 ACU 3	CARRIER 48GSN048	BUILDING 14 ROOF	ROOFTOP GAS/ELECTRIC	PRINT SHOP 101, CRON PLATE 104, OFFICE 113	1,600	-	4	105	10.0	NAT. GAS	74.9	60.0	80.1	208	3	60	23.7	35	R-22	-	1 3 4
(E) BL 14 ACU 4	CARRIER 48GSN060	BUILDING 14 ROOF	ROOFTOP GAS/ELECTRIC	PRINT SHOP 101	2,000	-	5	105	10.0	NAT. GAS	74.9	60.0	80.1	208	3	60	31.1	45	R-22	-	1 3 4
(E) BL 14 ACU 5	CARRIER 48GSN060	BUILDING 14 ROOF	ROOFTOP GAS/ELECTRIC	PRINT SHOP 101	2,000	-	5	105	10.0	NAT. GAS	74.9	60.0	80.1	208	3	60	31.1	45	R-22	-	1 3 4
(E) BL 14 ACU 6	CARRIER 48GSN060	BUILDING 14 ROOF	ROOFTOP GAS/ELECTRIC	PRINT SHOP 101	2,000	-	5	105	10.0	NAT. GAS	74.9	60.0	80.1	208	3	60	31.1	45	R-22	-	1 3 4

- 1

EXISTING HVAC UNIT. SCOPE IS LIMITED TO REFURBISHING AND REPLACING CONTROLS.
- 2

CLEAN AND REFURBISH ROOFTOP UNIT: REPLACE ANY BELTS AND FILTERS, CLEAN ALL COILS.
- 3

REBALANCE AND RESHEAVE UNIT AS NECESSARY TO PROVIDE SPECIFIED SUPPLY CFM. MEASURE EXISTING SYSTEM AIRFLOWS AT ALL DIFFUSERS TO CONFIRM EXISTING SUPPLY AIRFLOW OF 1,200 CFM.
- 4

REPLACE EXISTING RTU SPACE TEMPERATURE SENSOR WITH NEW TITLE 24 COMPLAINT ALERTON SPACE TEMPERATURE SENSOR. REPLACE UNIT COMMUNICATION CARD WITH BACNET COMPATIBLE COMM CARD FROM RTU MANUFACTURER.

SPLIT SYSTEM AIR CONDITIONING UNITS

FAN COIL UNIT							CONDENSING UNIT							COOLING					REFRIGERANT	NOTES		
MARK	MANUFACTURER MODEL	LOCATION / SERVICE	TYPE	SA FAN		OPERATING WEIGHT LBS.	SUPPORT/ ANCHORAGE DETAIL	MARK	MANUFACTURER MODEL	LOCATION	TYPE	NAMEPLATE		OPERATING WEIGHT LBS.	SUPPORT/ ANCHORAGE DETAIL	AMB °F	EDB/EWB °F	TOT MBH			NOM. CAP. (TONS)	SEER
				AIRFLOW CFM	V/PH							MCA MOCP	V/PH									
BL 14 FC-1	CARRIER 40MAQB30B	BUILDING 14 IDF	HIGH WALL DUCTLESS	870	208/1	45	4/M6.03	BL 14 CU-1	CARRIER 38MAQB30R	BLDG 14 ROOF	AIR COOLED	20 30	208/1	150	1/M6.01	100	80/67	30	2.5	19.8	R-410A	1 2 3 4

- 1

INDOOR UNIT POWERED FROM OUTDOOR UNIT.
- 2

UNIT SHALL BE SET FOR COOLING ONLY OPERATION (HEATING LOCKOUT).
- 3

PROVIDE WITH WIRED TITLE 24 COMPLIANT THERMOSTAT. PROVIDE TEMPERATURE SENSOR AND INTEGRATE SYSTEM INTO EXISTING CAMPUS ENERGY MANAGEMENT SYSTEM BY ALERTON.
- 4

PROVIDE WITH LOW AMBIENT KIT.

EXHAUST FANS

MARK	MANUFACTURER & MODEL	LOCATION	TYPE	SERVICE	FAN				MOTOR					OPERATING WEIGHT LBS.	SUPPORT/ ANCHORAGE DETAIL	NOTES
					AIRFLOW CFM	ESP IN WG.	ESP W/ BDD	RPM	HP	BHP (WATTS)	VOLTS	PHASE	RPM			
EF-1	GREENHECK CUE-070-VG	BLDG 14 ROOF	CENTRIFUGAL UPBLAST	CRON PLATE 104	180	0.2	0.315	1725	1/10	0.02	120	1	1725	45	2 / M-602	1 2 3 6 7
EF-2	GREENHECK SP-A190	MEN 111	CEILING MOUNT	MEN 111	140	0.2	0.3	1255	1/10	(34)	120	1	1400	18	4 / M-602	2 3 4 5
EF-3	GREENHECK SP-A190	WOMEN 112	CEILING MOUNT	WOMEN 112	140	0.2	0.3	1255	1/10	(34)	120	1	1400	18	4 / M-602	2 3 4 5

- 1

PROVIDE WITH INTEGRAL BACKDRAFT DAMPER AND ALUMINUM BIRD SCREEN.
- 2

PROVIDE WITH EC MOTOR WITH SPEED CONTROLLER ON MOTOR.
- 3

PROVIDE INTEGRAL TOGGLE TYPE DISCONNECT WITH THERMAL OVERLOAD PROTECTION.
- 4

PROVIDE ARCHITECTURAL CEILING GRILLE ACCESSORY. SUBMIT TO ARCHITECT FOR APPROVAL.
- 5

INTEGRATE INTO EXISTING CAMPUS ALERTON ENERGY MANAGEMENT SYSTEM (ON/OFF AND STATUS ONLY). COORDINATE WITH CAMPUS FACILITIES FOR HOURS OF OPERATION.
- 6

PROVIDE PRE-MANUFACTURED 12" ROOF CURB.
- 7

INTERLOCK WITH BL 14 ACU 3 FOR OPERATION.

GRILLES, REGISTERS, DIFFUSERS

MARK	DESCRIPTION	MATERIAL	BORDER	MODULE SIZE	DAMPER	FINISH	REMARKS
CD-1	TITUS PCS	STEEL	LAY-IN	24"X24"	NO	#26 WHITE	1 2 3
RG-1	TITUS PAR	STEEL	LAY-IN	24"X24"	NO	#26 WHITE	1 2 3
EG-1	TITUS PAR	STEEL	LAY-IN	24"X24"	NO	#26 WHITE	2 3

- 1

PROVIDE WITH INSULATED BACKING.
- 2

CONFIRM FINISH WITH OWNER AND ARCHITECT.
- 3

NECK SIZE AS SHOWN ON PLANS.



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STORK, WOLFE & ASSOCIATES
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YUCAIPA, CA 92399

SHEET TITLE

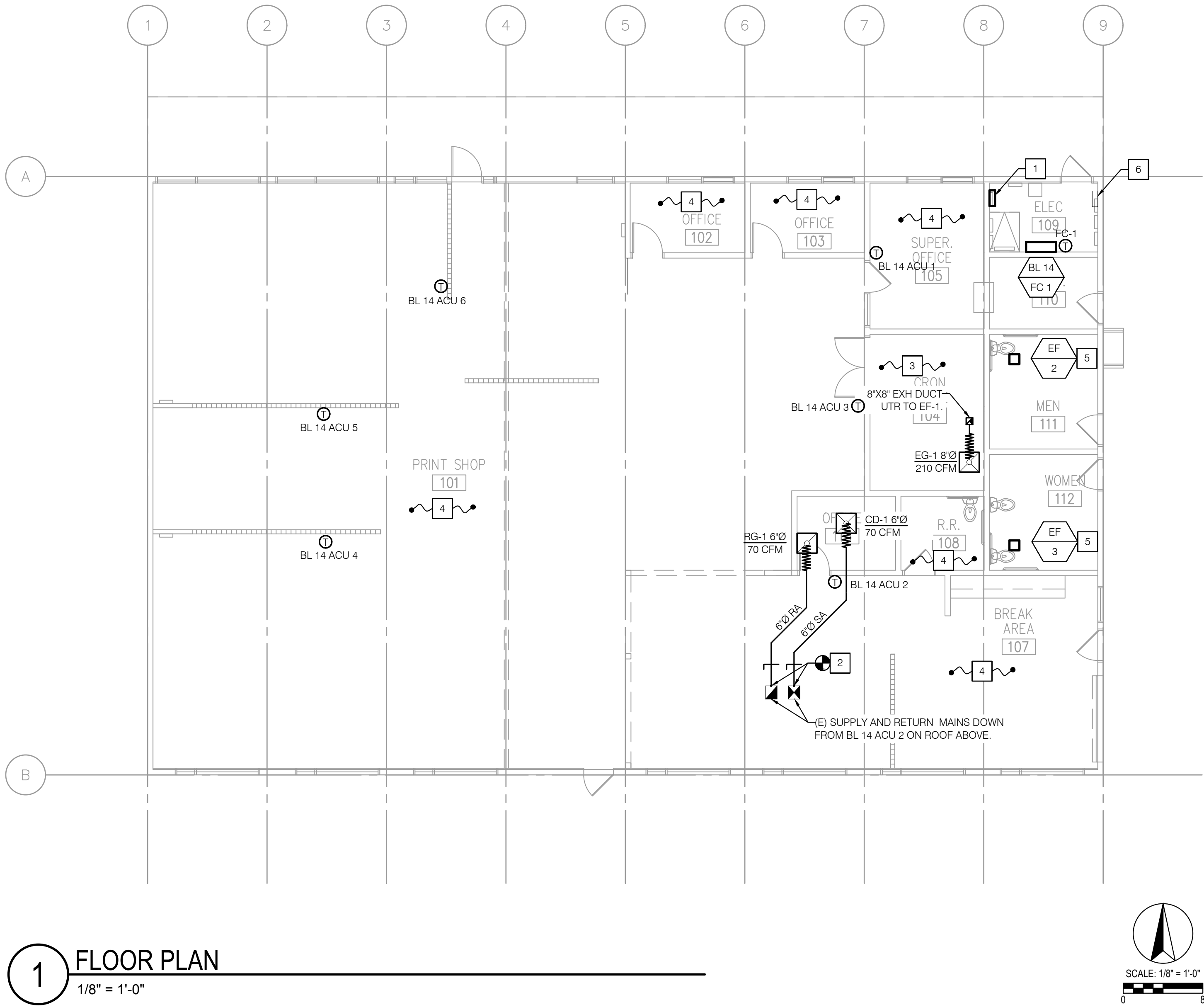
SCHEDULES

DRAWN BY: MH/QPJOB NUMBER: 18116.03

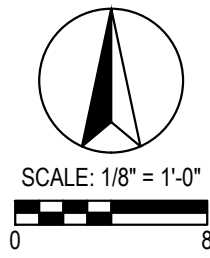
SHEET NO.

M-002

DATE: NOVEMBER 2, 2018SHEET ____ OF ____



1 FLOOR PLAN
1/8" = 1'-0"



NOTES

1. NEW ALERTON BUILDING CONTROLLER IN NEW 24"X24" WALL MOUNT CONTROL PANEL. EXACT PANEL LOCATION AND ELEVATION TO BE COORDINATED WITH EXISTING EQUIPMENT IN FIELD.
2. NEW 6"Ø TAPS OFF EXISTING SUPPLY AND RETURN PLENUM DROPS.
3. MEASURE AIRFLOWS AT EXISTING SUPPLY AND RETURN GRILLES IN THIS ROOM (2 SUPPLY, 2 RETURN) PRIOR TO THE START OF DEMOLITION. SUBMIT REPORT OF AIRFLOWS TO ENGINEER FOR REVIEW. DEMOLISH ONE (1) RETURN GRILLE, REMOVING ALL CONNECTED FLEX DUCT. CAP AND SEAL REMAINING DUCT.
4. ALL DUCTWORK AND DISTRIBUTION EQUIPMENT IN THIS ROOM IS EXISTING TO REMAIN.
5. REPLACE EXHAUST FAN IN PLACE. RECONNECT TO EXISTING EXHAUST DUCTWORK.
6. EXISTING SIEMENS APOGEE PANEL SERVING BLDG 15 TO REMAIN. CUT AND CAP COMM LINES FOR BLDG 14 FROM SIEMENS PANEL.

GENERAL NOTES

1. ALL NEW SUPPLY AND RETURN DUCTWORK SHALL BE INSULATED TO A MINIMUM INSTALLED R-VALUE OF R-8.0
2. NOT ALL EXISTING DUCTWORK AND DISTRIBUTION SHOWN. ALL EXISTING DUCTWORK NOT SHOWN ON PLANS SHALL BE PROTECTED IN PLACE THROUGHOUT CONSTRUCTION.
3. DRAWINGS BASED ON LIMITED AVAILABLE AS-BUILT DOCUMENTATION AND FIELD INVESTIGATION. EQUIPMENT AND DUCT LOCATIONS SHOWN ARE NOT INTENDED TO BE DIMENSIONED FROM THIS PLAN. ADJUST AS REQUIRED TO SUIT FIELD CONDITIONS. IF SIGNIFICANT CONFLICT EXISTS, SUBMIT TO ENGINEER FOR CLARIFICATION.
4. ALL ZONE TEMPERATURE SENSORS IN SCOPE OF WORK TO BE NEW. CONNECT TO HVAC UNITS AND CAMPUS EMS SYSTEM AS DETAILED ON M5.01.



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SHEET TITLE

FLOOR PLAN

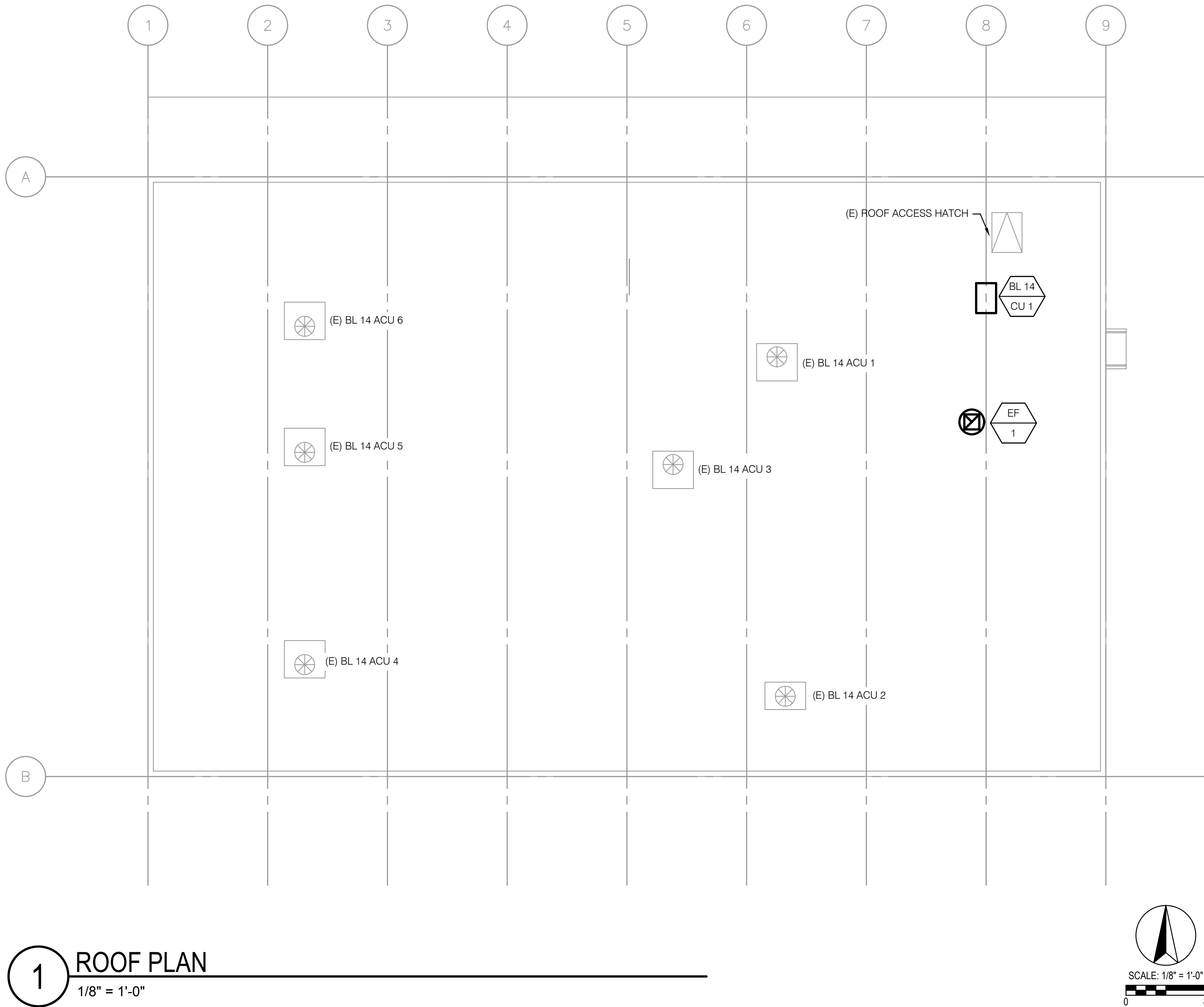
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SHEET NO.

M-201

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

PLOT BY: SCOTT NEWMAN
PLOT DATE: Nov 02, 2018 - 11:59AM
DRAWING NAME: R:\0463\MECHANICAL\0463_170222_ROOF_PLAN.dwg



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SHEET TITLE

ROOF PLAN

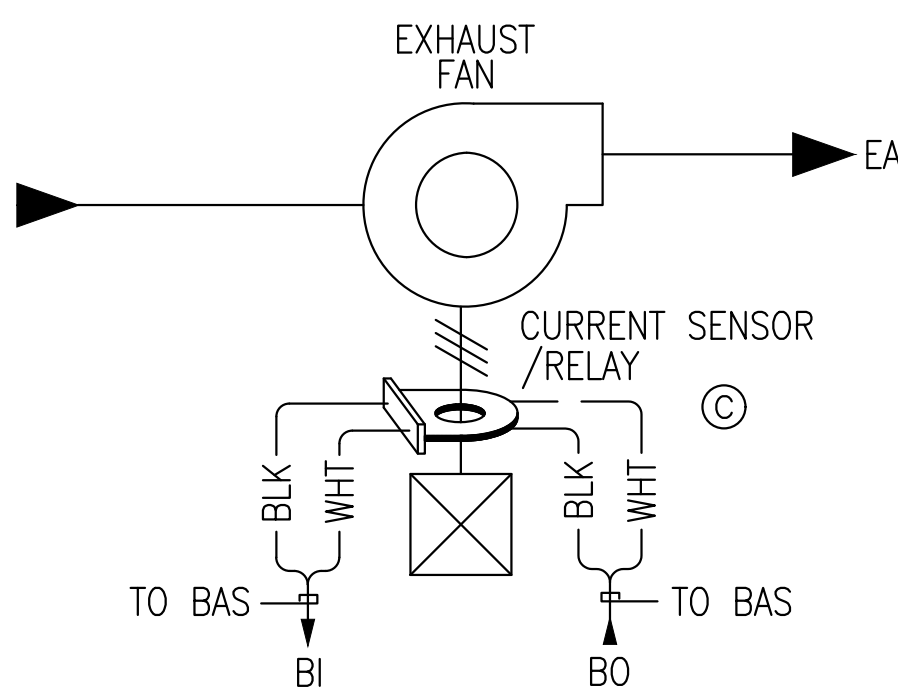
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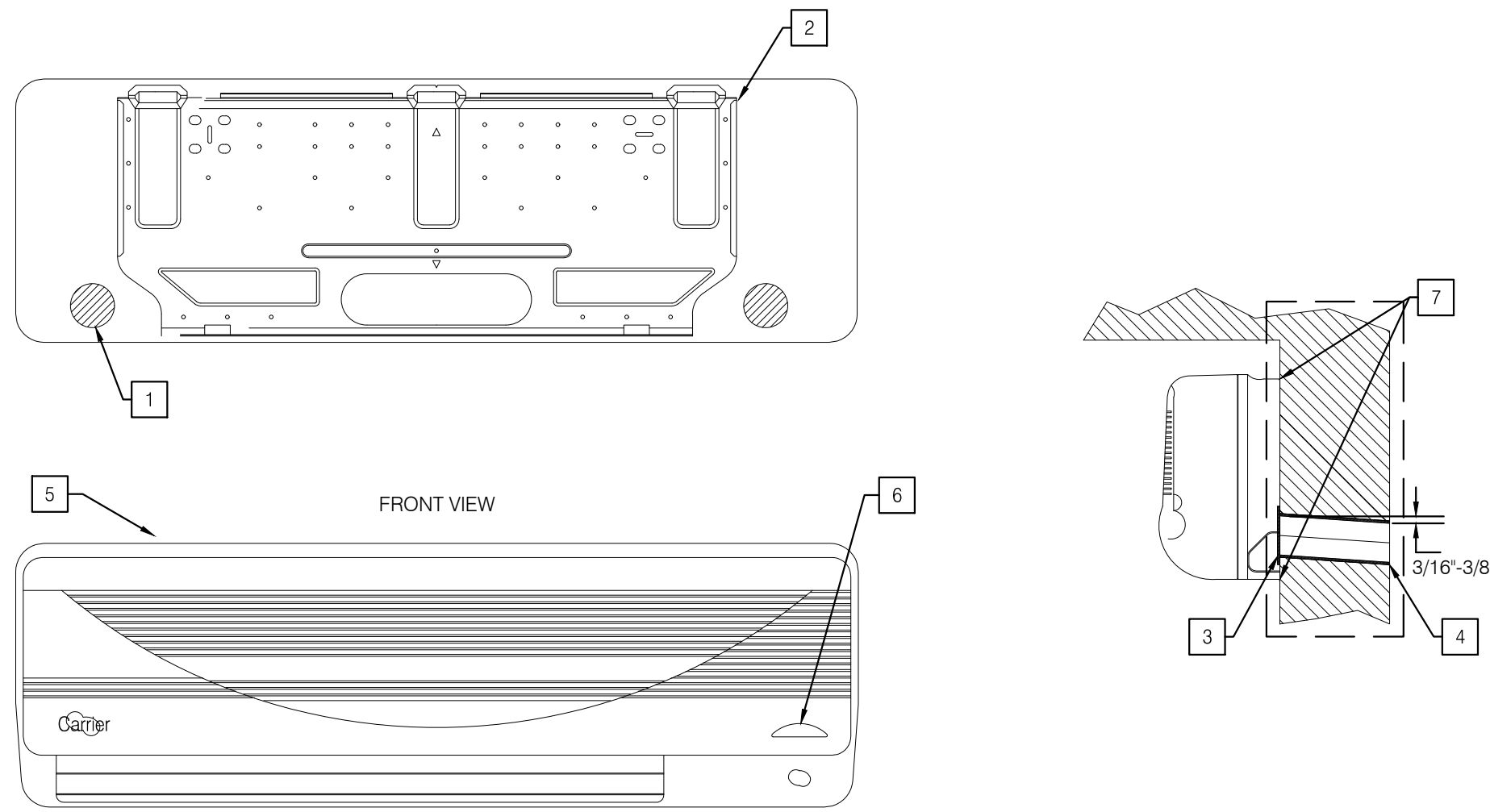
JOB NUMBER: 18116.03

SHEET NO.

M-202

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____





NOTES

- 2-1/2\" DIA. KNOCKOUT PANELS FOR REFRIGERANT, DRAIN, POWER AND SIGNAL LINES.
- MOUNTING BRACKET.
- WALL SLEEVE.
- 2-1/2\" DIA FOR REFRIGERANT, DRAIN, POWER AND SIGNAL LINES.
- AUTO AIRSWEEP LOUVER.
- INFRARED REMOTE OVERRIDE SWITCH (BEHIND ACCESS COVER).

NOTES

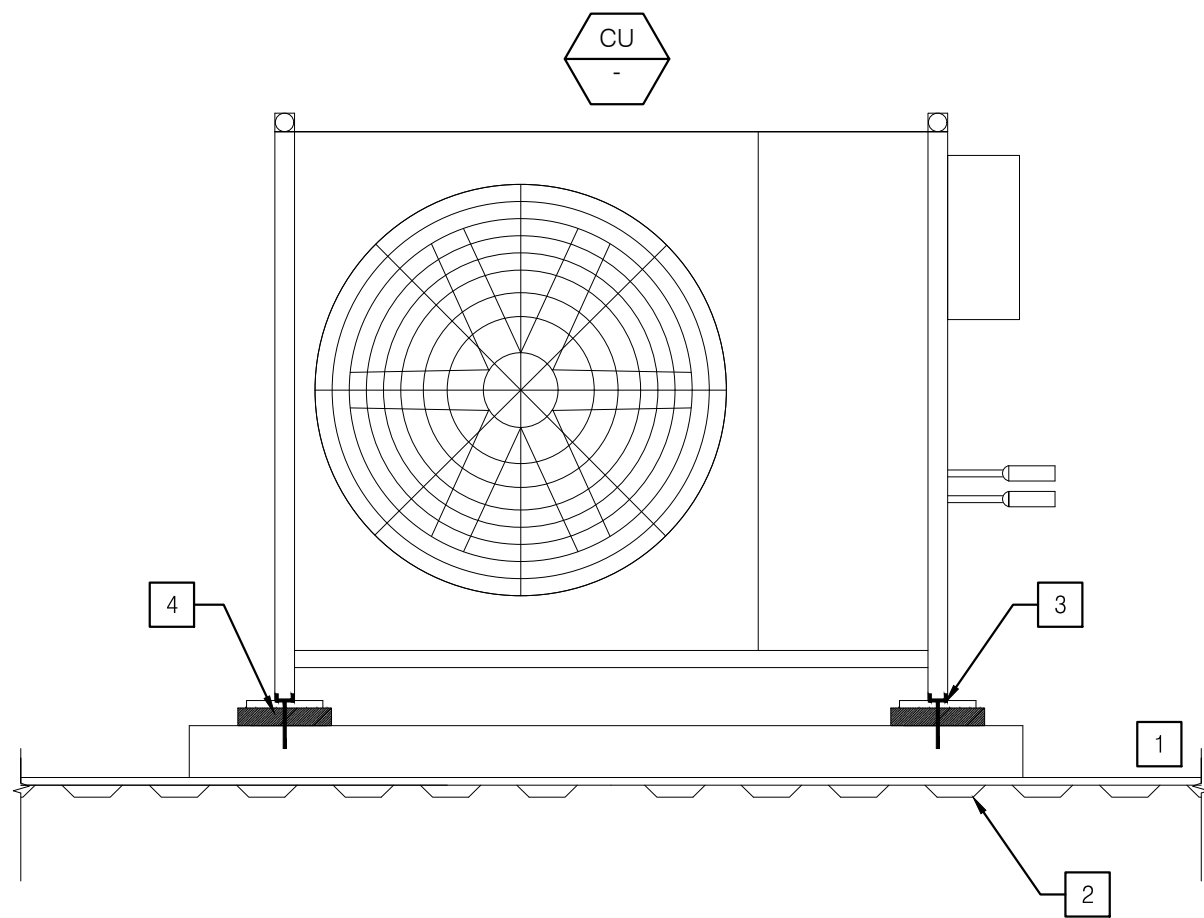
- FOR ATTACHMENT TO:
1. WOOD STUD FRAMING- PROVIDE 3/8\" LAG SCREW AT 24\" O.C. WITH 3-1/2\" EMBED INTO (N) BLOCKING PER STRUCTURAL DETAIL 7/S-102.

NOTES

- REFRIGERANT, DRAIN, AND POWER CONNECTIONS MAY BE MADE IN UNIT, REAR, BOTTOM, LEFT SIDE OR RIGHT SIDE. INSTALL UNIT AS INSTRUCTED BY MANUFACTURER.

4 WALL MOUNTED FAN COIL SUPPORT

NO SCALE

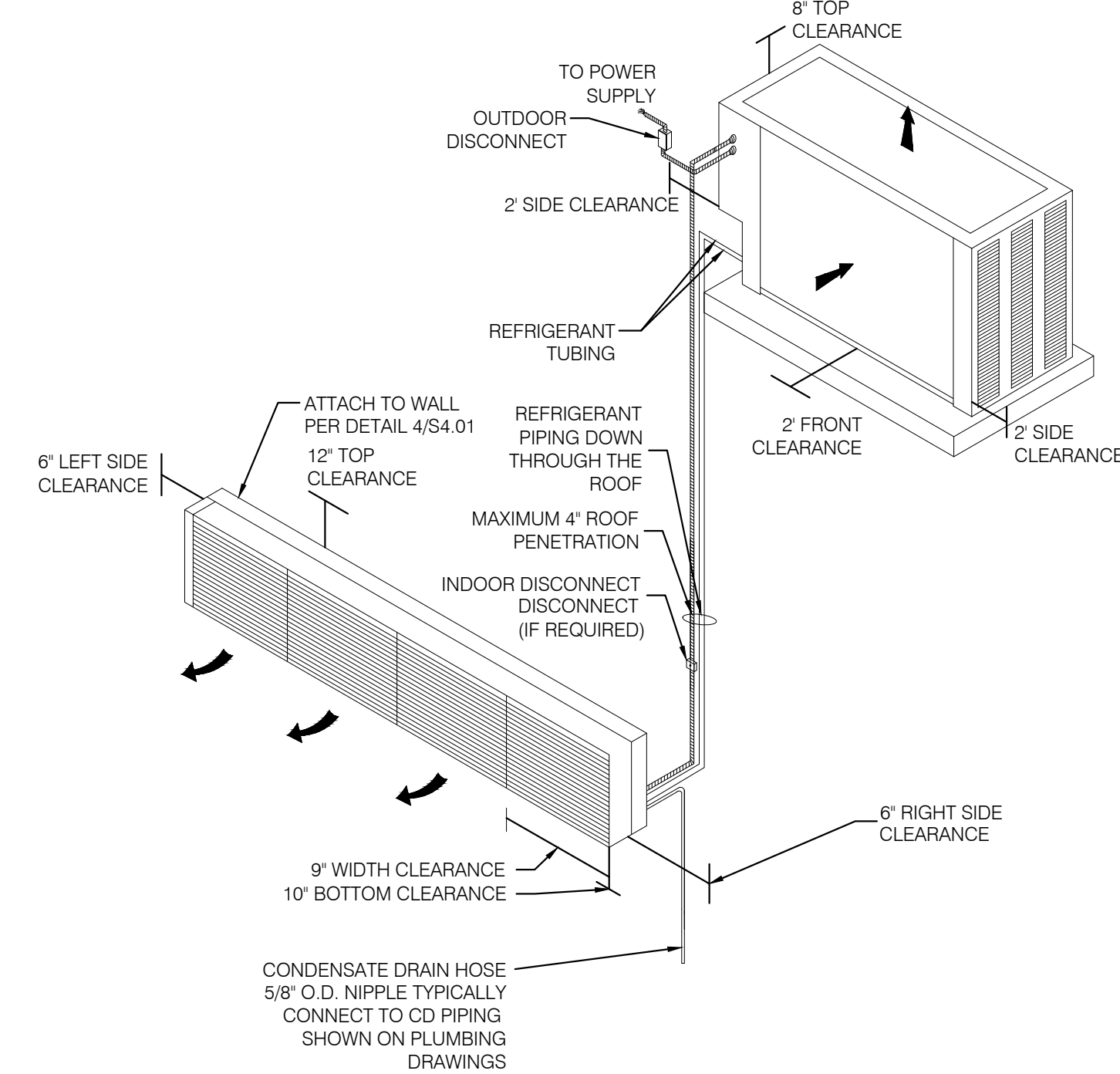


NOTES

- MIN. 8\" ROOF CURB. REFER TO ARCHITECTURAL DETAIL 2/A-202 FOR CURB, FLASHING, AND WATERPROOFING DETAILS.
- EXISTING ROOF DECK. SEE ARCH DWGS FOR REFERENCE
- ANCHOR TO WOOD ROOF CURB WITH 3/8\" LAG BOLT, MIN. 2.5\" EMBED.
- 3/4\" NEOPRENE PAD

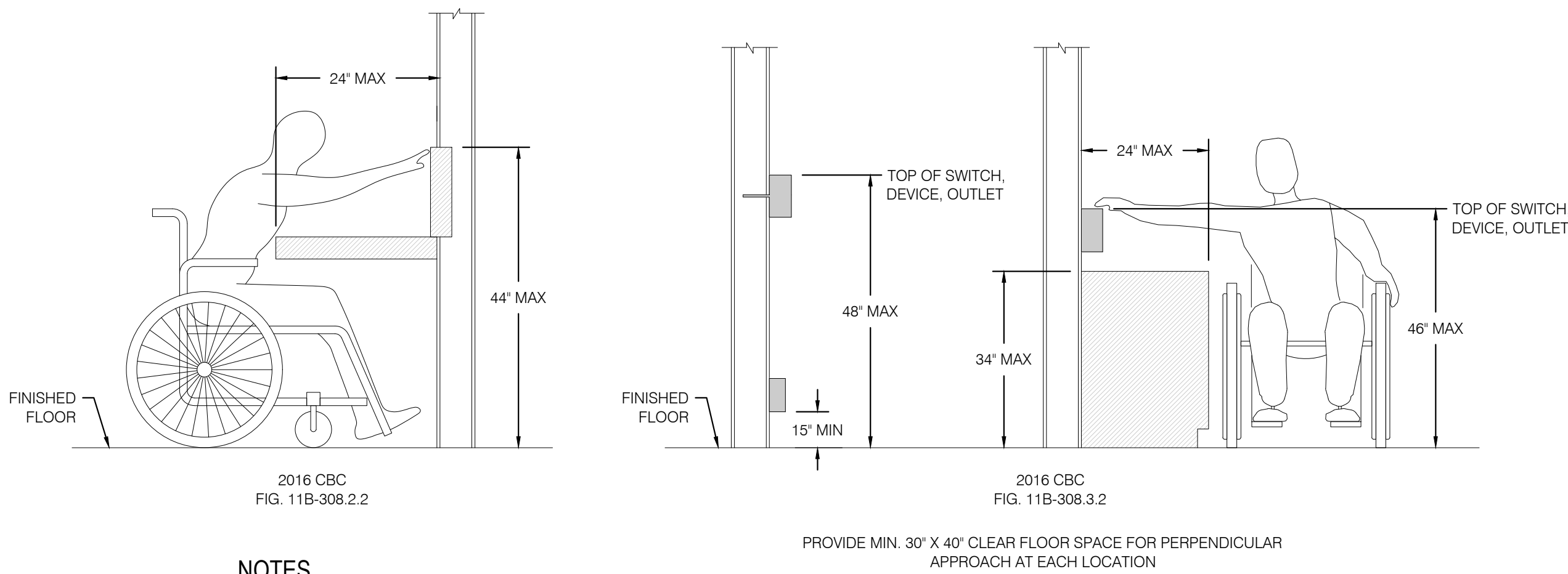
3 CONDENSING UNIT MOUNTING

NO SCALE



2 SPLIT SYSTEM INSTALLATION

NO SCALE



NOTES

- THIS DETAIL APPLIES TO MOUNTING OF ANY MECHANICAL AND ELECTRICAL DEVICE WHICH CONTAINS AN OPERABLE PART THAT IS ADJUSTABLE BY THE OCCUPANT. THIS DOES NOT APPLY TO SENSORS OR CONTROLS THAT ARE ONLY ADJUSTABLE THROUGH THE BUILDING AUTOMATION SYSTEM (IE: TEMPERATURE AND HUMIDITY SENSORS).

1 THERMOSTAT MOUNTING OVER OBSTRUCTION

NO SCALE

PMSM
ARCHITECTS

196
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DETAILS

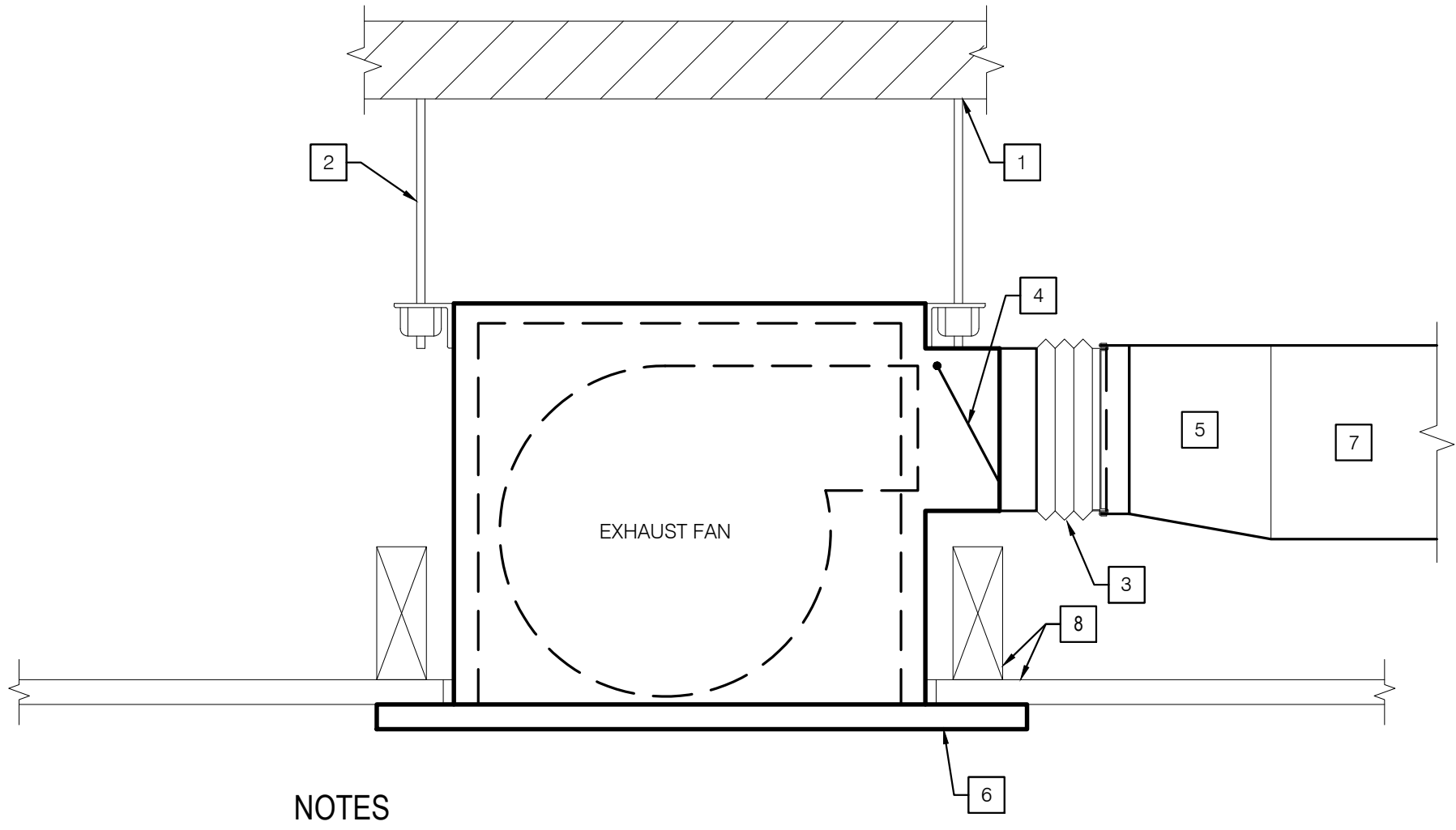
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JOB NUMBER: 18116.03

SHEET NO.

M-601

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____



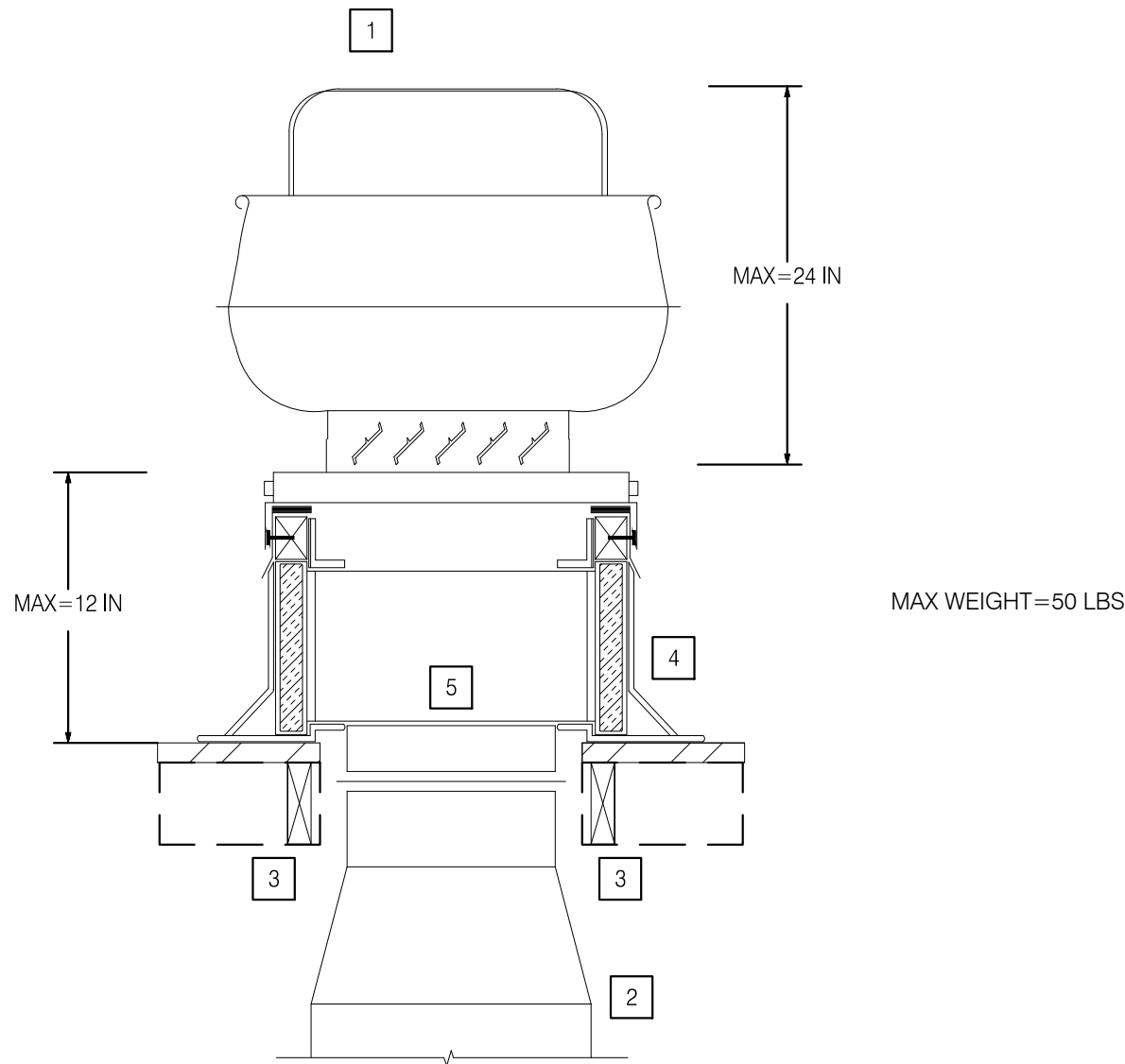
NOTES

- 1 ATTACH TO STRUCTURE PER SMACNA STANDARDS.
- 2 3/8" STEEL HANGER RODS (4 REQ.).
- 3 FLEX CONNECTOR TO FAN.
- 4 BACKDRAFT DAMPER.
- 5 TRANSITION AS REQUIRED.
- 6 EXHAUST GRILLE/FAN ACCESS.
- 7 EXHAUST DUCT. SEE FLOOR PLANS FOR SIZE.
- 8 GYPSUM BOARD CEILING WITH FRAMING.

4

CEILING EXHAUST FAN DETAIL

NO SCALE



NOTES

- 1 PROVIDE EXHAUST FAN ON MINIMUM 1'-0" HIGH, 18 GAUGE GALVANIZED STEEL, FACTORY FURNISHED ROOF CURB WITH 1-1/2" 3 POUND THERMAL AND ACOUSTICAL INSULATION. PROVIDE NEOPRENE RUBBER GASKET BETWEEN FAN AND CURB. SECURE FAN TO CURB WITH MINIMUM FOUR 1/2" DIAMETER A307 MACHINE BOLT AND NUT (ONE AT EACH CORNER). PROVIDE BACKDRAFT DAMPER AT FAN INLET.
- 2 PROVIDE GALVANIZED STEEL EXHAUST AIR DUCT UP THROUGH ROOF CURB AND CONNECT TO FAN INTAKE. PROVIDE FLEX CONNECTION BEFORE FINAL CONNECTION.
- 3 REFER TO STRUCTURAL DRAWINGS, FOR FRAMING REQUIREMENTS.
- 4 REFER TO ARCHITECTURAL DETAIL 2/A-202 FOR ROOFING, FLASHING AND ROOF OPENING REQUIREMENTS.
- 5 SEE ARCHITECTURAL PLANS FOR ROOF OPENING REPAIR REQUIREMENTS. MAX OPENING SIZE IS 8 SQ FT.

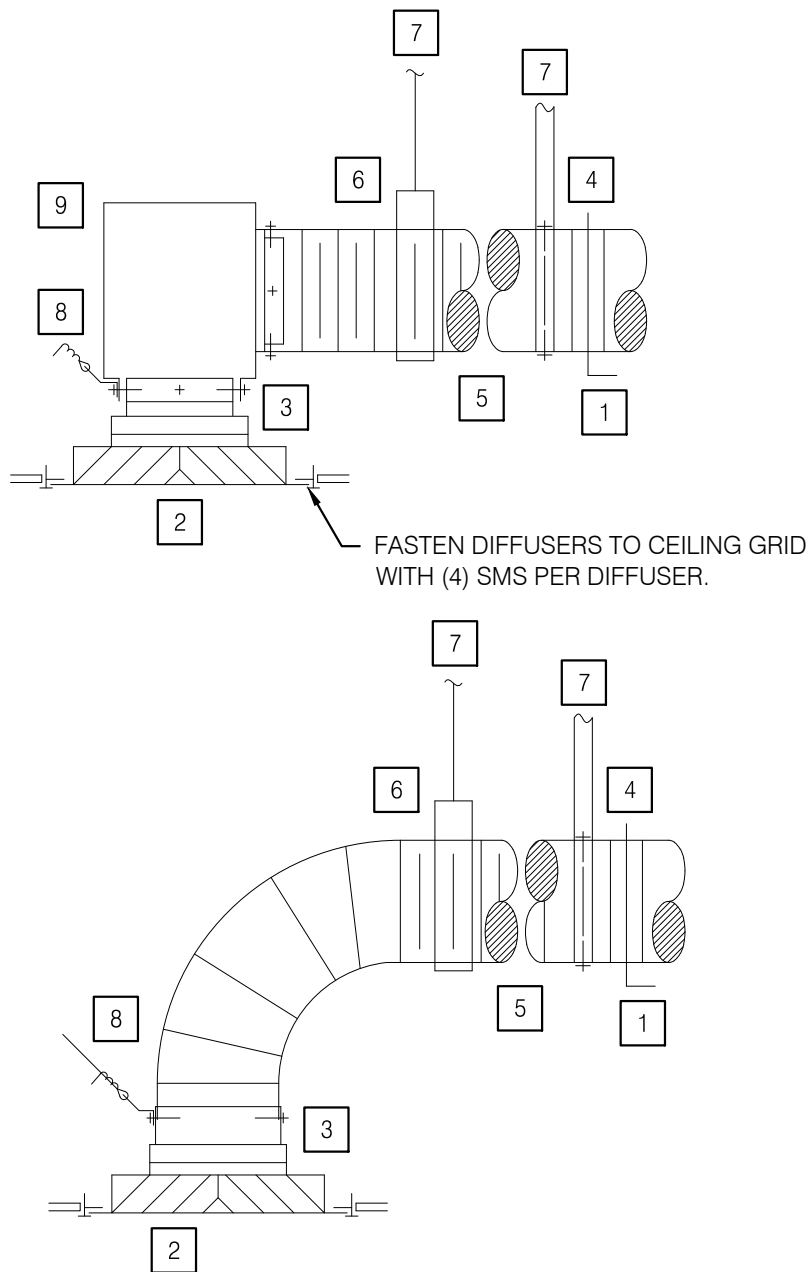
2

EXHAUST FAN MOUNTING

NO SCALE

NOTES

- 1 PROVIDE MANUAL VOLUME DAMPER NEAR MAIN DUCT CONNECTION. MANUAL VOLUME DAMPER SHALL BE LOCKING QUADRANT TYPE AS MANUFACTURED BY DURO-DYNE SPECILINE ELEVATED DAMPER REGULATOR WITH HEX NUT.
- 2 CEILING DIFFUSER SUPPORTED ONTO CEILING. REFER TO ARCHITECTURAL REFLECTED CEILING PLAN FOR EXACT CEILING TYPES.
- 3 RECTANGULAR OR SQUARE TO ROUND CEILING CAN SECURED TO DIFFUSER WITH MINIMUM 4, #10 SHEET METAL SCREWS AND SEAL AIRTIGHT WITH CASCOTE DUCT SEALANT. IF REQUIRED, PROVIDE ADDITIONAL GALVANIZED STEEL DUCTWORK TO ALLOW FOR STRAIGHT DUCT RUN DOWN TO CEILING DIFFUSER.
- 4 CONNECT RIGID DUCT WITH MINIMUM 3, #10 SHEET METAL SCREWS AND SEAL WITH CASCOTE DUCT SEALANT. SUPPORT RIGID DUCT TO STRUCTURE ABOVE WITH SHEET METAL STRAPS PER 2016 CMC.
- 5 FLEX DUCT SHALL NOT EXCEED MAXIMUM LENGTH OF 5'-0". FLEX DUCT SHALL BE CASCO SILENTFLEX II.
- 6 PROVIDE 1-1/2" WIDE, 22 GAUGE HANGER STRAP FOR DUCT SUPPORT. CONNECT 12 GAUGE WIRE FOR SUPPORT TO STRUCTURE ABOVE. WIRE SHALL BE USED OF FLEX DUCT ONLY.
- 7 REFER TO STRUCTURAL DRAWINGS FOR ATTACHMENT TO STRUCTURE ABOVE.
- 8 PROVIDE 1"X3" LONG, 16 GAUGE BENT CLIP SECURED TO DIFFUSER WITH #10 SHEET METAL SCREWS. TWO PER DIFFUSER AT DIAGONAL. SECURE 12 GAUGE WIRE TO STRUCTURE ABOVE.
- 9 ALTERNATE CEILING DIFFUSER CONNECTION AT SHALLOW CEILING SPACE LOCATIONS. PROVIDE GALVANIZED STEEL PLENUM AND INSULATE EXTERIOR. SECURE TO CEILING DIFFUSER WITH MINIMUM FOUR #10 SHEET METAL SCREWS AND SEAL AIR TIGHT WITH CASCOTE DUCT SEALANT.



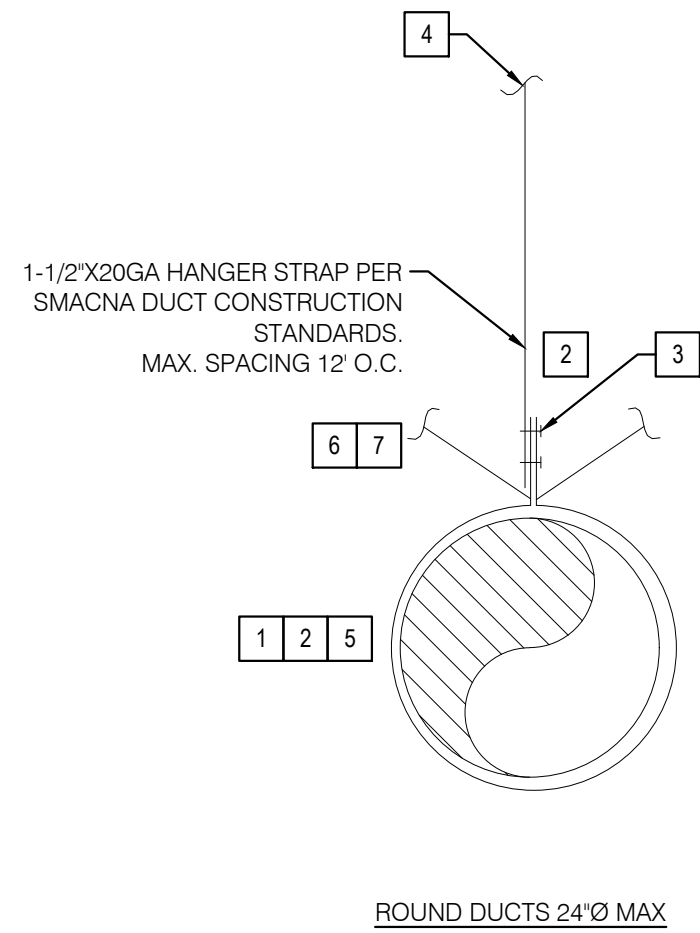
3

CEILING DIFFUSER CONNECTION

NO SCALE

NOTES

- 1 REFER TO DRAWINGS FOR DUCT SIZES. FOR ADDITIONAL DUCT SUPPORT AND OTHER DUCT CONSTRUCTION REQUIREMENTS REFER TO SMACNA DUCT CONSTRUCTION STANDARDS.
- 2 GALVANIZED STEEL DUCT HANGER STRAPS. ROUND DUCT SUPPORTS SHALL BE PROVIDED AT MAXIMUM 12'-0" ON CENTER FOR STRAIGHT LENGTH OF DUCT AND MAXIMUM 2'-0" ON CENTER AT ALL ELBOWS AND DUCT TRANSITIONS. RECTANGULAR DUCT SUPPORTS SHALL BE PROVIDED AT MAXIMUM 10'-0" ON CENTER FOR STRAIGHT LENGTH OF DUCT AND MAXIMUM 2'-0" ON CENTER AT ALL ELBOWS AND DUCT TRANSITIONS.
- 3 SECURE GALVANIZED STEEL HANGER STRAP TO DUCT STRAP WITH TWO (2) #10 x 5/8" TEK SCREW.
- 4 HANGER STRAPS TO BE ATTACHED TO STRUCTURE AS DETAILED ON STRUCTURAL DRAWINGS.
- 5 PER CBC 1616A.1.25, DIAGONAL BRACING IS NOT REQUIRED FOR HVAC DUCTWORK WITH IP = 1 IF EITHER OF THE FOLLOWING CONDITIONS ARE MET:
A. DUCTS ARE SUSPENDED FROM HANGERS 12 IN. OR LESS IN LENGTH AND HANGERS ARE DETAILED TO AVOID SIGNIFICANT BENDING OF THE HANGERS AND THEIR ATTACHMENTS
OR
B. DUCTS HAVE A CROSS-SECTIONAL AREA OF LESS THAN 6 SQFT OR A WEIGHT OF LESS THAN 10 LB PER LINEAR FOOT.
- 6 PROVIDE BRACING WIRE FOR RESTRAINT AT 10' O.C. WHERE REQUIRED. REFER TO STRUCTURAL DRAWINGS FOR CONNECTION TO STRUCTURE ABOVE.
- 7 CONNECT BRACING WIRE TO DUCT WITH CEILING CLIP. USE (2) #10 SHEET METAL SCREWS FOR CONNECTION.



1

ROUND DUCT SUPPORT

NO SCALE



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SHEET TITLE

DETAILS

DRAWN BY: MH/QP

JOB NUMBER: 18116.03

SHEET NO.

M-602

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

PLOT BY: SCOTT NEWMAN
PLOT DATE: NOV 02, 2018 - 11:59AM
DRAWING NAME: R:\0463\MECHANICAL\9463_1701_TITLE 24.dwg

STATE OF CALIFORNIA
HVAC SYSTEM REQUIREMENTS
CEC-NRCC-MCH-02-E (Revised 01/16)

CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE
HVAC Wet System Requirements
NRCC-MCH-02-E
(Page 3 of 3)

Project Name: TESS CENTER T.I. AT CRAFTON HILLS COLLEGE BL 14
Date Prepared: 10/19/2018

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT
1. I certify that this Certificate of Compliance documentation is accurate and complete.

Documentation Author Name: SCOTT NEWMAN
Signature Date: 10/19/2018

Company: P2S INC.
Address: 5000 E SPRING STREET, STE 800
City/State/Zip: LONG BEACH, CA, 90815
Phone: 562.497.2999

RESPONSIBLE PERSON'S DECLARATION STATEMENT
I certify the following under penalty of perjury, under the laws of the State of California:
1. The information provided on this Certificate of Compliance is true and correct.
2. I am eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design or system design identified on this Certificate of Compliance (responsible designer).
3. The energy features and performance specifications, materials, components, and manufactured devices for the building design or system design identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the California Code of Regulations.
4. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.
5. I will ensure that a completed signed copy of this Certificate of Compliance shall be made available with the building permit(s) issued for the building, and made available to the enforcement agency for approval with this building permit application.
I understand that a completed signed copy of this Certificate of Compliance is required to be included with the documentation the builder provides to the building owner at occupancy.

Responsible Designer Name: SCOTT NEWMAN
Signature Date: 10/19/2018

Company: P2S INC.
Address: 5000 E SPRING STREET, STE 800
City/State/Zip: LONG BEACH, CA, 90815
Phone: 562.497.2999

CA Building Energy Efficiency Standards - 2016 Nonresidential Compliance

January 2016

STATE OF CALIFORNIA
HVAC DRY & WET SYSTEM REQUIREMENTS
CEC-NRCC-MCH-02-E (Revised 01/16)

CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE
HVAC Dry System Requirements
NRCC-MCH-02-E
(Page 1 of 3)

Project Name: TESS CENTER T.I. AT CRAFTON HILLS BL 14
Date Prepared: 10/19/2018

A. Equipment Tags and System Description¹- Dry Systems
MANDATORY MEASURES
Heating Equipment Efficiency³
Cooling Equipment Efficiency³
HVAC or Heat Pump Thermostats
Furnace Standby Loss Control
Low Leakage AHUs
Ventilation⁴
Demand Control Ventilation⁵
Occupant Sensor Ventilation Control⁶
Shutoff and Reset Controls⁷
Outdoor Air and Exhaust Damper Control
Isolation Zones
Automatic Demand Shed Controls
Economizer FDD
Duct Insulation
PRESCRIPTIVE MEASURES
Equipment is sized in conformance with 140.4 (a & b)
Supply Fan Pressure Control
Simultaneous Heat/Cool⁸
Economizer
Heat and Cool Air Supply Reset
Electric Resistance Heating⁹
Duct Leakage Sealing and Testing.¹⁰

CU/FC-1

Reference to the Requirements in the Contract Documents²

110.1 or 110.2(a) M-002

110.1 or 110.2(a) M-002

110.2(b), 110.2(c) M-002

110.2(d) N/A

110.2(e) N/A

120.1(a) N/A

120.1(c)(5), 120.2(e)3 N/A

120.2(f) N/A

120.2(g) N/A

120.2(h) N/A

120.2(i) N/A

120.4 N/A

140.4(a & b) Yes No Yes No Yes No

140.4(c) N/A

140.4(d) N/A

140.4(e) N/A

140.4(f) N/A

140.4(g) N/A

140.4(i) N/A

Notes:
1. Provide equipment tags (e.g. AHU 1 to 10) and system description (e.g. Single Duct VAV reheat) as appropriate. Multiple units with common requirements can be grouped together.
2. Provide references to plans (i.e. Drawing Sheet Numbers) and/or specifications (including Section name/number and relevant paragraphs) where each requirement is specified. Enter "N/A" if the requirement is not applicable to this system.
3. The referenced plans and specifications must include all of the following information: equipment tag, equipment nominal capacity, Title 24 minimum efficiency requirements, and actual rated equipment efficiencies. Where multiple efficiency requirements are applicable (e.g. full- and part-load) include all. Where appliance standards apply (110.1), identify where equipment is required to be listed per Title 20 1601 et seq.
4. Identify where the ventilation requirements are documented for each central HVAC system. Include references to both central unit schedules and sequences of operation. If one or more spaces is naturally ventilated identify where this is documented in the plans and specifications. Multiple zone central air systems must also provide a MCH-03-E compliance document.
5. If one or more spaces has demand controlled ventilation identify where it is specified including the sensor specifications and the sequence of operation.
6. If one or more space has occupant sensor ventilation control identify where it is specified including the sensor specifications and the sequence of operation
7. If the system is DDC identify the sequences for the system start/stop, optimal start, setback (if required) and setup (if required). For all systems identify the specification for the thermostats and time clocks (if applicable).
8. Identify where the heating, cooling and deadband airflow are scheduled for this system. Include a reference to the specification of the zone controls. Provide a MCH-03-E compliance document.
9. Enter N/A if there is no electric heating. If the system has electric heating indicate which exception to 140.4(g) applies.
10. If duct leakage sealing and testing is required, a MCH-04-A compliance document must be submitted.

CA Building Energy Efficiency Standards - 2016 Nonresidential Compliance

January 2016

STATE OF CALIFORNIA
MECHANICAL SYSTEMS
CEC-NRCC-MCH-01-E (Revised 01/16)

CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE
Mechanical Systems
NRCC-MCH-01-E
Page of

Project Name: TESS CENTER T.I. AT CRAFTON HILLS COLLEGE BL 14
Date Prepared: 10/19/2018

C. MECHANICAL HVAC ACCEPTANCE FORMS (check box for required compliance documents)

Test Performed By:

Designer:
This compliance document is to be used by the designer and attached to the plans. Listed below are all the acceptance tests for HVAC systems. The designer is required to check the applicable boxes for all acceptance tests that apply and list all equipment that requires an acceptance test. All equipment of the same type that requires a test, list the equipment description and the number of systems.
Installing Contractor:
The contractor who installed the equipment is responsible to either conduct the acceptance test themselves or have a qualified entity run the test for them. If more than one person has responsibility for the acceptance testing, each person shall sign and submit the Certificate of Acceptance applicable to the portion of the construction or installation for which they are responsible.
Enforcement Agency:
Plancheck - The NRCC-MCH-01-E compliance document is not considered a completed document and is not to be accepted by the building department unless the correct boxes are checked.

Test Description	# of Units	MCH-12-A	MCH-13-A	MCH-14-A	MCH-15-A	MCH-16-A	MCH-17-A	MCH-18-A
Equipment Requiring Testing or Verification		Fault Detection & Diagnostics for DX Units	Automatic Fault Detection & Diagnostics for Air & Zone	Distributed Energy Storage DX AC Systems	Thermal Energy Storage (TES) Systems	Supply Air Temperature Reset Controls	Condenser Water Reset Controls	ECMS
CU/FC-1	1							

CA Building Energy Efficiency Standards - 2016 Nonresidential Compliance

January 2016

STATE OF CALIFORNIA
MECHANICAL SYSTEMS
CEC-NRCC-MCH-01-E (Revised 01/16)

CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE
Mechanical Systems
NRCC-MCH-01-E
Page of

Project Name: TESS CENTER T.I. AT CRAFTON HILLS COLLEGE BL 14
Date Prepared: 10/19/2018

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT
1. I certify that this Certificate of Compliance documentation is accurate and complete.

Documentation Author Name: SCOTT NEWMAN
Signature Date: 10/19/18

Company: P2S INC.
Address: 5000 E SPRING STREET, STE 800
City/State/Zip: LONG BEACH, CA, 90815
Phone: 562.497.2999

RESPONSIBLE PERSON'S DECLARATION STATEMENT
I certify the following under penalty of perjury, under the laws of the State of California:
1. The information provided on this Certificate of Compliance is true and correct.
2. I am eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design or system design identified on this Certificate of Compliance (responsible designer).
3. The energy features and performance specifications, materials, components, and manufactured devices for the building design or system design identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the California Code of Regulations.
4. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.
5. I will ensure that a completed signed copy of this Certificate of Compliance shall be made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a completed signed copy of this Certificate of Compliance is required to be included with the documentation the builder provides to the building owner at occupancy.

Responsible Designer Name: SCOTT NEWMAN
Signature Date: 10/19/18

Company: P2S INC.
Address: 5000 E SPRING STREET, STE 800
City/State/Zip: LONG BEACH, CA, 90815
Phone: 562.497.2999

CA Building Energy Efficiency Standards - 2016 Nonresidential Compliance

January 2016

STATE OF CALIFORNIA
MECHANICAL SYSTEMS
CEC-NRCC-MCH-01-E (Revised 01/16)

CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE
Mechanical Systems
NRCC-MCH-01-E
Page of

Project Name: TESS CENTER T.I. AT CRAFTON HILLS COLLEGE BL 14
Date Prepared: 10/19/2018

A. MECHANICAL COMPLIANCE DOCUMENTS & WORKSHEETS (check box if worksheet is included)

For detailed instructions on the use of this and all Energy Efficiency Standards compliance forms, refer to the 2016 Nonresidential Manual
Note: The Enforcement Agency may require all forms to be incorporated onto the building plans.

YES	NO	Comp. Doc./Worksheet #	Title
☒	☐	NRCC-MCH-01-E (Part 1 of 3)	Certificate of Compliance, Declaration. Required on plans for all submittals.
☒	☐	NRCC-MCH-01-E (Part 2 of 3)	Certificate of Compliance, Required Acceptance Tests (MCH-02-A to 11-A). Required on plans for all submittals.
☒	☐	NRCC-MCH-01-E (Part 3 of 3)	Certificate of Compliance, Required Acceptance Tests (MCH-12-A to 18-A). Required on plans where applicable.
☒	☐	NRCC-MCH-02-E (Part 1 of 2)	Mechanical Dry Equipment Summary is required for all submittals with Central Air Systems. It is optional on plans.
☐	☒	NRCC-MCH-02-E (Part 2 of 2)	Mechanical Wet Equipment Summary is required for all submittals with chilled water, hot water or condenser water systems. It is optional on plans.
☐	☒	NRCC-MCH-03-E	Mechanical Ventilation and Reheat is required for all submittals with multiple zone heating and cooling systems. It is optional on plans.
☐	☒	NRCC-MCH-07-E (Part 1 of 2)	Power Consumption of Fans. Required on plans where applicable
☐	☒	NRCC-MCH-07-E (Part 2 of 2)	Power Consumption of Fans, Declaration. Required on plans where applicable

B. MECHANICAL HVAC ACCEPTANCE FORMS (check box for required compliance documents)

Test Performed By:

Designer:
This compliance document is to be used by the designer and attached to the plans. Listed below are all the acceptance tests for HVAC systems. The designer is required to check the applicable boxes for all acceptance tests that apply and list all equipment that requires an acceptance test. All equipment of the same type that requires a test, list the equipment description and the number of systems.
Installing Contractor:
The contractor who installed the equipment is responsible to either conduct the acceptance test themselves or have a qualified entity run the test for them. If more than one person has responsibility for the acceptance testing, each person shall sign and submit the Certificate of Acceptance applicable to the portion of the construction or installation for which they are responsible.
Enforcement Agency:
Plancheck - The NRCC-MCH-01-E compliance document is not considered a completed document and is not to be accepted by the building department unless the correct boxes are checked.

Test Description	# of Units	MCH-02-A	MCH-03-A	MCH-04-A	MCH-05-A	MCH-06-A	MCH-07-A	MCH-08-A	MCH-09-A	MCH-10-A	MCH-11-A
Equipment Requiring Testing or Verification		Outdoor Air	Single Zone Unitary	Air Distribution Ducts	Economizer Controls	Demand Controlled Ventilation (DCV)	Supply Fan VAV	Valve Leakage Test	Supply Water Temp. Reset	Hydronic System Variable Flow Control	Automatic Demand Shed Control
CU/FC-1	1		☒								

CA Building Energy Efficiency Standards - 2016 Nonresidential Compliance

January 2016



19.6
ARCHITECTS

802 EAST COTA STREET, SUITE A
SANTA BARBARA, CA 93103
TEL (805) 963-1955

CONSULTANTS

MECHANICAL, ELECTRICAL,
PLUMBING ENGINEER

P2S ENGINEERING, INC.
5000 East Spring Street, Suite 800
Long Beach, CA 90815
TEL (562) 497-2999 FAX (562) 497-2990

STRUCTURAL ENGINEER
STORK, WOLFE & ASSOCIATES
555 Chorro Street, Suite A1
San Luis Obispo, CA 93405
TEL (805) 548-8600

ARCHITECT STAMP CONSULTANT STAMP

BID SET
NOT
APPROVED

AGENCY APPROVAL

REVISIONS

THE ARCHITECT DOES NOT REPRESENT THAT THESE PLANS OR THE SPECIFICATIONS ARE SUITABLE FOR ANY SITE OTHER THAN THE ONE FOR WHICH THEY WERE SPECIFICALLY PREPARED. THE ARCHITECT DISCLAIMS RESPONSIBILITY FOR THESE PLANS AND SPECIFICATIONS IF THEY ARE USED IN WHOLE OR IN PART AT ANY OTHER SITE

PROJECT OWNER & TITLE

SAN BERNARDINO
COMMUNITY COLLEGE DIST.

PRINT SHOP T.I. AT
CRAFTON HILLS
COLLEGE BL 14
11711 SAND CANYON ROAD
YUCAIPA, CA 92399

SHEET TITLE

TITLE 24
COMPLIANCE
FORMS

DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

M-701

DATE: NOVEMBER 2, 2018 SHEET ____ OF

LEGEND

SYMBOL	DESCRIPTION
	NOTE CALLOUT
	DETAIL CALLOUT - NUMBER ON TOP DENOTES DETAIL NUMBER - NUMBER ON BOTTOM DENOTES SHEET DETAIL IS SHOWN
	MECHANICAL EQUIPMENT CALLOUT. SEE MECHANICAL PLANS FOR EXACT LOCATION AND REQUIREMENTS
	SECTION CALLOUT
	POINT OF CONNECTION
	POINT OF DISCONNECTION
	CHANGING PIPE SIZE
	NEW PIPE (SIZE-SERVICE)
	EXISTING PIPE/EQUIPMENT
	DEMOLISHED PIPE/EQUIPMENT
	LOW PRESSURE NATURAL GAS
	MEDIUM PRESSURE NATURAL GAS
	HIGH PRESSURE NATURAL GAS
	SANITARY SEWER/WASTE UNDERGROUND
	SANITARY SEWER/WASTE ABOVEGROUND
	SANITARY VENT
	DOMESTIC HOT WATER RETURN
	DOMESTIC HOT WATER SUPPLY
	DOMESTIC COLD WATER
	STORM DRAIN PIPING
	TEMPERED WATER
	CONDENSATE DRAIN
	VALVE AT DROP
	VALVE AT RISE
	ELBOW DOWN
	PIPE TEE UP & DOWN OR ELBOW UP
	PIPE TEE DOWN
	PIPE TEE UP
	SYMBOL DESCRIPTION
	SOLENOID VALVE
	GATE VALVE
	BALL VALVE
	PRESSURE REDUCING VALVE
	CHECK VALVE, SWING
	PLUG VALVE
	STRAINER, Y-TYPE
	FLOW METER
	BACKFLOW PREVENTER
	HOSE BIBB
	FLOOR DRAIN
	FLOOR SINK, 1/2 GRATE
	AREA DRAIN / INDUSTRIAL RECEPTOR
	SHUT-OFF VALVE IN YARDBOX
	BALANCING VALVE
	FLOOR CLEANOUT
	CLEANOUT TO GRADE
	WALL CLEANOUT
	WATER HAMMER ARRESTOR
	TRAP PRIMER

ABBREVIATIONS

ABBREVIATION	DESCRIPTION
@	AT
ABV	ABOVE
AC	ABOVE CEILING
AC	ACETYLENE
AD	AREA DRAIN
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AFSR	AUTOMATIC FIRE SPRINKLER RISER
ARGON GAS	ARGON GAS
AV	ACID VENT
AW	ACID WASTE
BEL	BELOW
BFP	BACKFLOW PREVENTER
B/G	BELOW GRADE
B/F	BELOW FLOOR
BTM	BOTTOM
BV	BALL VALVE
CI	CAST IRON
CIP	CAST IRON PIPE
CLG	CEILING
COTG	CLEAN-OUT TO GRADE
CUBC	CUBIC
CW	COLD WATER
DEPT	DEPARTMENT
DF	DRINKING FOUNTAIN
DIA	DIAMETER
DN	DOWN
DS	DOWNSPOUT
DWG	DRAWING(S)
(E)	EXISTING
EXIST	EXISTING
EQUIP	EQUIPMENT
EW	ELECTRIC WATER COOLER
F	FIRE
F/A	FROM ABOVE
F/B	FROM BELOW
FCO	FLOOR CLEAN-OUT
FD	FLOOR DRAIN
FF	FINISHED FLOOR
FM	FORCE MAIN
FS	FLOOR SINK
FT	FEET
G	NATURAL GAS (LOW PRESSURE)
GAL	GALLONS
GPM	GALLONS PER MINUTE
GPR	GAS PRESSURE REGULATOR
H&CW	HOT AND COLD WATER
H/L	HIGH LEVEL
HDR	HEADER
HT	HEIGHT
IN	INCHES
IW	INDIRECT WASTE
L or LAV	LAVATORY
MAX	MAXIMUM
MIN	MINIMUM
MPG	NATURAL, MEDIUM PRESSURE GAS
MTD	MOUNTED
NTS	NOT TO SCALE
O	OXYGEN
OD	OVERFLOW DRAIN
OS&Y	OPEN SCREW AND YOKE
POC	POINT OF CONNECTION
POD	POINT OF DISCONNECTION
PSI	POUNDS PER SQUARE INCH
RD	ROOF DRAIN
RI&C	ROUGH-IN AND CONNECT
S	SINK, SEWER, SOIL
SD	STORM DRAIN
SOV	SHUT-OFF VALVE
SQ	SQUARE
SS	SERVICE SINK
T/A	TO ABOVE
T/B	TO BELOW
TP	TRAP PRIMER
TYP	TYPICAL
UG	UNDERGROUND
UON	UNLESS OTHERWISE NOTED
UR	URINAL
V	SANITARY VENT
VOLT	VOLTAGE
VTR	VENT THRU ROOF
W	WASTE
W	WITH
WC	WATER CLOSET
WCO	WALL CLEAN-OUT
WH	WATER HEATER
WHA	WATER HAMMER ARRESTOR

IN THE EVENT ABBREVIATIONS NOT MENTIONED HEREIN ARE USED, REFERENCE WILL BE MADE TO ANSI Y1.1, MILITARY STANDARD ABBREVIATIONS, AND OTHER STANDARD INDUSTRY CONVENTIONS.

GENERAL NOTES

- ALL WORK SHALL COMPLY WITH THE 2016 EDITIONS OF THE CALIFORNIA BUILDING, MECHANICAL, PLUMBING, AND OTHER APPLICABLE FEDERAL, STATE, OR LOCAL CODES AS ADOPTED AND ENFORCED BY THE LOCAL JURISDICTION. IN CASE THE PLANS SHOW MORE STRINGENT REQUIREMENTS, THE PLANS SHALL GOVERN THE DESIGN, YET NOTHING ON THE DESIGN DOCUMENTS SHALL BE INTERPRETED AS AUTHORITY TO VIOLATE CODE(S) OR REGULATION(S).
- SUBMISSION OF BID IN CONNECTION WITH THIS WORK SHALL IMPLY THAT THE BIDDER HAS EXAMINED THE JOB SITE UNDER WHICH THE CONTRACTOR WILL BE OBLIGATED TO OPERATE UNDER THIS CONTRACT. NO EXTRA CHARGE WILL BE ALLOWED FOR FAILURE OF ANY BIDDER TO EXAMINE THE SITE PRIOR TO BID.
- WHERE USED, THE TERM "PROVIDE" SHALL MEAN "FURNISH AND INSTALL".
- IN THE EVENT OF A CONFLICT OR INCONSISTENCY BETWEEN ITEMS INDICATED ON DESIGN PLANS / SPECIFICATIONS WITH CODE REQUIREMENTS, THE MORE STRINGENT STANDARD SHALL PREVAIL.
- CONTRACTOR SHALL FURNISH LABOR, MATERIALS, EQUIPMENT, AND TRANSPORTATION AS REQUIRED TO PROPERLY INSTALL ALL PLUMBING SYSTEMS OR RELATED COMPONENTS AS INDICATED ON PLANS AND SPECIFIED HEREIN.
- ALL NEW EQUIPMENT AND MATERIAL TO BE INSTALLED AS PART OF RENOVATION / NEW CONSTRUCTION SHALL BEAR AN UNDERWRITERS LABORATORIES LABEL (UL), AND INSTALLED IN SUCH A MANNER FOR WHICH THEY ARE DESIGNED AND APPROVED.
- CONTRACTOR SHALL DOCUMENT AND RELAY ANY MAJOR DEVIATIONS FROM THE DESIGN DOCUMENTS, AND ATTAIN APPROVAL FROM THE MECHANICAL ENGINEER BEFORE PROCEEDING. AS-BUILT COPIES SHALL BE PROVIDED INDICATING ALL CHANGES / DEVIATIONS MADE DURING CONSTRUCTION. CONTRACTOR SHALL PROVIDE COMPLETED AS-BUILT DRAWINGS IN THE LATEST VERSION OF AUTOCAD.
- ALL WORK SHALL BE PERFORMED IN A CLEAN AND WORKMANLIKE MANNER. CARE SHALL BE EXERCISED TO MINIMIZE ANY INCONVENIENCE OR DISTURBANCE TO OTHER AREAS OF THE BUILDING WHICH ARE TO REMAIN IN OPERATION. ISOLATE WORK AREAS BY MEANS TO KEEP DUST AND DIRT WITHIN THE CONSTRUCTION AREA.
- NO PIPING, EQUIPMENT, ETC. SHALL BE REMOVED, DISCONNECTED OR SHUT DOWN WITHOUT PRIOR REVIEW WITH THE COLLEGE TO CONFIRM THAT AREAS TO REMAIN IN OPERATION WILL NOT BE AFFECTED. IF ANY AREAS NOT WITHIN THE SCOPE OF WORK ARE AFFECTED BY ANY SHUTDOWN, REMOVAL OR DISCONNECTION, SUFFICIENT ADVANCE NOTICE MUST BE GIVEN TO THE COLLEGE INDICATING WHICH AREAS WILL BE AFFECTED, WHEN THE PROPOSED SHUTDOWN WILL OCCUR, AND FOR HOW LONG A PERIOD OF TIME.
- THE ARRANGEMENT OF EQUIPMENT AND PIPING SHOWN ON THE DRAWINGS IS BASED UPON INFORMATION AVAILABLE TO THE ENGINEER AT THE TIME OF DESIGN AND IS NOT INTENDED TO SHOW EXACT DIMENSIONS PECULIAR TO A SPECIFIC MANUFACTURER. THE DRAWINGS ARE, IN PART, DIAGRAMMATIC AND SOME FEATURES OF THE ILLUSTRATED EQUIPMENT INSTALLATION MAY REQUIRE REVISION TO MEET ACTUAL EQUIPMENT INSTALLATION REQUIREMENTS. STRUCTURAL SUPPORTS, FOUNDATIONS, CONNECTED PIPING, VALVES, PIPE SUPPORTS AND ELECTRICAL CONDUIT SPECIFIED MAY HAVE TO BE ALTERED OR ADDITIONAL ITEMS REQUIRED TO ACCOMMODATE THE EQUIPMENT PROVIDED. NO ADDITIONAL PAYMENT WILL BE MADE FOR SUCH REVISIONS, ALTERATIONS AND / OR ADDITIONS.
- CONTRACTOR SHALL VERIFY ALL DIMENSIONS AT THE SITE MAKING FIELD MEASUREMENTS AND PROVIDE SHOP DRAWINGS NECESSARY FOR FABRICATION OR ERECTION OF ALL HVAC AND PIPING SYSTEMS. MAKE ALLOWANCE FOR BEAMS, PIPES AND OTHER OBSTRUCTIONS IN BUILDING CONSTRUCTION. CHECK DRAWINGS SHOWING WORK OF OTHER TRADES AND CONSULT WITH THE UNIVERSITY REPRESENTATIVE IN THE EVENT OF POTENTIAL INTERFERENCE. SHOP DRAWINGS SHALL BE MINIMUM 1/4"=1'-0" SCALE, INDICATING FITTINGS, SIZES, WELDS AND CONFIGURATIONS AND SUBMITTED TO ENGINEER FOR REVIEW. CONTRACTOR SHALL PROVIDE DIMENSIONED SHOP DRAWINGS COMPLETED IN THE LATEST VERSION OF AUTOCAD.
- CONTRACTOR SHALL COORDINATE HIS WORK WITH ALL OTHER TRADES PRIOR TO FABRICATION, PURCHASE AND/OR INSTALLATION OF ALL WORK.
- BEFORE COMMENCEMENT OF WORK, CONTRACTOR SHALL VERIFY THE EXACT LOCATIONS, ELEVATIONS, AND CHARACTERISTICS OF ALL UTILITIES.
- CONTRACTOR SHALL SECURE AND PAY ALL FEES AND PERMITS PERTAINING TO THE CONTRACT.
- EXISTING MATERIALS THAT ARE REMOVED SHALL NOT BE REUSED IN NEW SYSTEMS, EXCEPT WHERE INDICATED AS BEING RELOCATED.
- ALL EQUIPMENT SHALL BE INSTALLED IN STRICT COMPLIANCE WITH THE MANUFACTURERS WRITTEN INSTRUCTIONS.
- ALL VENTS TO TERMINATE MINIMUM 12 INCHES FROM ANY VERTICAL SURFACE AND 3 FEET VERTICAL AND 10 FEET HORIZONTALLY FROM ANY AIR CONDITIONING EQUIPMENT FRESH AIR INTAKES. NO FLAGPOLE PERMITTED.
- ALL PIPING SHALL BE INSTALLED AS INDICATED ON THE DRAWINGS IN A NEAT WORKMANSHIP-LIKE MANNER AND BE SUPPORTED AS REQUIRED BY CODES. PIPING SHALL BE SET UP AND DOWN AND OFFSET AS REQUIRED TO SUIT FIELD CONDITIONS. DIELECTRIC COUPLINGS SHALL BE USED WHERE DISSIMILAR METALS ARE JOINED.
- ALL PIPING DISCHARGING INTO FLOOR-SINKS AND/OR FLOOR DRAINS SHALL MAINTAIN MINIMUM AIR-GAP AS REQUIRED BY LOCAL CODES.
- ALL VALVES, UNIONS, ETC. TO BE SAME SIZE AS LINE SIZE UNLESS OTHERWISE INDICATED ON DRAWINGS.
- ISOLATE AND DRAIN EXISTING PIPING SYSTEM AS REQUIRED TO ACCOMMODATE INSTALLATION OF THE WORK.
- UNIONS SHALL BE PROVIDED AND INSTALLED AFTER EACH SCREW-TYPE VALVE AND PRIOR TO EQUIPMENT CONNECTIONS.
- EQUIPMENT ANCHORAGE NOTES:
 - ALL PERMANENT EQUIPMENT AND COMPONENTS.
 - TEMPORARY OR MOVABLE EQUIPMENT THAT IS PERMANENTLY ATTACHED (E.G. HARD WIRED) TO THE BUILDING UTILITY SERVICES SUCH AS ELECTRICITY, GAS OR WATER.
 - MOVABLE EQUIPMENT WHICH IS STATIONED IN ONE PLACE FOR MORE THAN 8 HOURS AND HEAVIER THAN 400 POUNDS ARE REQUIRED TO BE ANCHORED WITH TEMPORARY ATTACHMENTS.

ALL MECHANICAL, PLUMBING, AND ELECTRICAL COMPONENTS SHALL BE ANCHORED AND INSTALLED PER THE DETAILS ON THE DSA APPROVED CONSTRUCTION DOCUMENTS. WHERE NO DETAIL IS INDICATED, THE FOLLOWING COMPONENTS SHALL BE ANCHORED OR BRACED TO MEET THE FORCE AND DISPLACEMENT REQUIREMENTS PRESCRIBED IN THE 2016 CBC, SECTIONS 1616.10.1 THROUGH 1616.10.24 AND ASCE 7-10 CHAPTER 6 AND 30.

- ALL PERMANENT EQUIPMENT AND COMPONENTS.
- TEMPORARY OR MOVABLE EQUIPMENT THAT IS PERMANENTLY ATTACHED (E.G. HARD WIRED) TO THE BUILDING UTILITY SERVICES SUCH AS ELECTRICITY, GAS OR WATER.
- MOVABLE EQUIPMENT WHICH IS STATIONED IN ONE PLACE FOR MORE THAN 8 HOURS AND HEAVIER THAN 400 POUNDS ARE REQUIRED TO BE ANCHORED WITH TEMPORARY ATTACHMENTS.

THE ATTACHMENT OF THE FOLLOWING MECHANICAL AND ELECTRICAL COMPONENTS SHALL BE POSITIVELY ATTACHED TO THE STRUCTURE, BUT NEED NOT BE DETAILED ON THE PLANS. THESE COMPONENTS SHALL HAVE FLEXIBLE CONNECTIONS PROVIDED BETWEEN THE COMPONENT AND ASSOCIATED DUCTWORK, PIPING, AND CONDUIT.

- COMPONENTS WEIGHING LESS THAN 400 POUNDS AND HAVE A CENTER OF MASS LOCATED 4 FEET OR LESS ABOVE THE ADJACENT FLOOR OR ROOF LEVEL THAT DIRECTLY SUPPORT THE COMPONENT.
- COMPONENTS WEIGHING LESS THAN 20 POUNDS, OR IN THE CASE OF DISTRIBUTED SYSTEMS, LESS THAN 5 POUNDS PER FOOT, WHICH ARE SUSPENDED FROM A ROOF OR FLOOR OR HUNG FROM A WALL.

FOR THOSE ELEMENTS THAT DO NOT REQUIRE DETAILS ON THE APPROVED DRAWINGS, THE INSTALLATION SHALL BE SUBJECT TO THE APPROVAL OF THE STRUCTURAL ENGINEER OF RECORD AND THE DSA DISTRICT STRUCTURAL ENGINEER. THE PROJECT INSPECTOR WILL VERIFY THAT ALL COMPONENTS AND EQUIPMENT HAVE BEEN ANCHORED IN ACCORDANCE WITH ABOVE REQUIREMENTS.

24. PIPING, DUCTWORK, AND ELECTRICAL DISTRIBUTION SYSTEM BRACING NOTE:

PIPING, DUCTWORK, AND ELECTRICAL DISTRIBUTION SYSTEMS SHALL BE BRACED TO COMPLY WITH THE FORCES AND DISPLACEMENTS PRESCRIBED IN ASCE 7-10 SECTION 13.3 AS DEFINED IN ASCE 7-10 SECTION 13.6.8, 13.6.7, 13.6.5.6 ITEM 6, AND 2016 CBC SECTIONS 1616.10.17, 1616.10.18 AND 1616.10.19.

THE BRACING AND ATTACHMENTS TO THE STRUCTURE SHALL BE DETAILED ON THE APPROVED DRAWINGS OR THEY SHALL COMPLY WITH ONE OF THE OSHPD PRE-APPROVALS (OP# #) AS MODIFIED TO SATISFY ANCHORAGE REQUIREMENTS OF ACI 318, APPENDIX D.

COPIES OF THE MANUAL SHALL BE AVAILABLE ON THE JOBSITE PRIOR TO THE START OF HANGING AND BRACING OF THE PIPE, DUCTWORK, AND ELECTRICAL DISTRIBUTION SYSTEM.

THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE TO SUPPORT THE HANGER AND BRACE LOADS.

25. PLUMBING FIXTURES AND FAUCETS SHALL BE CERTIFIED BY THE STATE OF CALIFORNIA ENERGY COMMISSION AS REQUIRED BY THE CALIFORNIA ENERGY EFFICIENCY STANDARDS SECTION 9-5314 AND TABLE "G".

26. ALL SOIL, WASTE, STORM DRAIN AND VENT PIPING SHALL SLOPE AT 2% UNLESS OTHERWISE INDICATED.

27. PIPING THROUGH FIRE RATED WALLS SHALL BE PER U.L. FIRE RESISTANCE SYSTEM NO. W1001. SEE ARCHITECTURAL PLANS FOR ALL WALL LOCATIONS.

28. REFER TO THE SPECIFICATIONS BOOK FOR ADDITIONAL REQUIREMENTS.

29. ALL CLEANOUTS SHALL BE INSTALLED WHERE READILY ACCESSIBLE. THE CONTRACTOR SHALL COORDINATE ALL CLEANOUT LOCATIONS WITH EQUIPMENT, CABINETS, ETC. AND THE ARCHITECT PRIOR TO ANY INSTALLATION.

30. KEEP ALL PIPING FROM LOAD BEARING FOOTINGS. IF UNABLE TO CLEAR FOOTINGS OR GRADE BEAMS, INSTALL PIPING THROUGH PIPE SLEEVES.

31. BEFORE FABRICATION AND INSTALLATION, THE CONTRACTOR SHALL VERIFY EXACT LOCATIONS OF ALL EQUIPMENT AND FIXTURES. EXACT ROUGH-IN LOCATIONS AND REQUIREMENTS SHALL BE COORDINATED IN FIELD.

32. ACCESSIBLE PLUMBING FIXTURES SHALL COMPLY WITH ALL OF THE REQUIREMENTS OF 2016 CBC CHAPTER 11A AND/OR 11B. HEIGHTS AND LOCATION OF ALL FIXTURES SHALL BE ACCORDING TO CBC 2016 SECTION 1138A. FIXTURE CONTROLS SHALL COMPLY WITH CBC 2016 SECTION 1138A.4.

33. ALL VALVES, TRAP PRIMERS, WATER HAMMER ARRESTERS OR OTHER EQUIPMENT SHOWN IN WALLS OR ABOVE NON-ACCESSIBLE CEILINGS SHALL BE INSTALLED BEHIND AN ACCESS PANEL.

34. VERIFY WITH ARCHITECTURAL DRAWINGS FOR EXACT LOCATIONS OF ALL FLOOR DRAINS, ROOF, OVERFLOW DRAINS AND FLOOR SINKS.

35. FIXTURES SHALL BE PROTECTED DURING CONSTRUCTION FROM ANY DAMAGES. REFINISHED FIXTURES WILL NOT BE ACCEPTABLE UNDER ANY CONDITIONS.

36. HOSE BIB WITH VACUUM BREAKER SHALL BE PROVIDED UNDER LAVATORY IN EACH PUBLIC RESTROOM.

37. INSULATE INDIRECT DRAIN LINES FROM REFRIGERATORS, FREEZERS, ICE MAKER AND ICE BINS WITH MANVILLE AERO-TUBE OR EQUAL TO PREVENT CONDENSATE DRIPS.

38. INSULATE WASTE PIPE AND P-TRAP FROM FLOOR SINK, FLOOR DRAINS OR FUNNEL DRAINS COLLECTING INDIRECT DRAINS FROM REFRIGERATORS, FREEZERS, ICE MAKER AND ICE BINS TO PREVENT CONDENSATE DRIPS. INSULATE WASTE PIPE UP TO THE NEXT 3" OR 4" MAIN CONNECTION.

39. PROVIDE AND INSTALL GAS COCKS AND UNION AT EACH GAS FIRED EQUIPMENT.

40. PROVIDE AND INSTALL CHROME ANGLE VALVES ON HOT AND COLD WATER SUPPLY AT EACH PLUMBING FIXTURES.

41. ALL WATER FAUCETS SHALL BE PROVIDED WITH CODE APPROVED FLOW RESTRICTORS.

42. COVER ALL FLOOR DRAINS, FLOOR SINKS, ROOF AND OVERFLOW DRAINS DURING CONSTRUCTIONS TO PREVENT DEBRIS FROM ENTERING PIPE AND PROTECT GRATES FROM DAMAGES.

43. COORDINATE WITH ELECTRICAL CONTRACTOR PRIOR TO ORDERING EQUIPMENT FOR AVAILABLE VOLTAGES AT ALL EQUIPMENT LOCATIONS.

44. COORDINATE WITH ELECTRICAL CONTRACTOR FOR ALL TAMPER AND FLOW SWITCH LOCATIONS.

45. BECAUSE OF THE SMALL SCALE DRAWINGS, IT IS NOT POSSIBLE TO INDICATE ALL OFFSETS, FITTINGS AND ACCESSORIES WHICH MAY BE REQUIRED. THE CONTRACTOR SHALL CAREFULLY INVESTIGATE THE CONDITIONS SURROUNDING INSTALLATION OF HIS WORK, FURNISHING THE NECESSARY PIPING, FITTINGS, VALVES, TRAPS, AND OTHER DEVICES WHICH MAY BE REQUIRED TO COMPLETE THE INSTALLATION.

46. UNLESS SPECIFIED ON STRUCTURAL DRAWINGS, ANY ALTERATION OR MODIFICATIONS TO STRUCTURAL ELEMENTS BY CUTTING, DRILLING, BORING, BRACING, WELDING ETC. SHALL HAVE WRITTEN APPROVAL STRUCTURAL ENGINEER PRIOR TO START WORK.

47. ITEMS NOT SHOWN IN THE DRAWINGS BUT NECESSARY FOR COMPLETE OPERATION OF THE SYSTEM/FIXTURES/EQUIPMENT OR FOR COMPLETE CODE INSTALLATION SHALL BE PROVIDED AT NO ADDED COST TO THE OWNER.

48. DIELECTRIC UNION ISOLATOR WITH THREADED CONNECTIONS SHALL BE PROVIDED FOR CONNECTING INCOMPATIBLE MATERIALS.

49. ALL PLUMBING FIXTURES SHALL BE APPROVED BY OWNER PRIOR TO ORDERING.

50. CONTRACTOR SHALL FIELD VERIFY EXACT LOCATION OF ALL EXISTING UTILITIES TO WHERE HE IS TO CONNECT PRIOR TO INSTALLATION OF ANY PIPING. EXTEND NEW PIPING IF NECESSARY TO WHERE THE EXISTING IS.

51. ALL CONNECTIONS TO EXISTING SERVICES SHALL BE MADE SUCH THAT INTERRUPTION TIME WILL BE AS SHORT AS POSSIBLE. THE CONTRACTOR SHALL GIVE THE OWNERS REPRESENTATIVE SUFFICIENT NOTICE OF SUCH INTERRUPTION AND THE ACTUAL SHUT DOWN TIME SHALL BE AT A TIME DESIGNATED BY THE OWNERS REPRESENTATIVE.

52. ALL EXISTING PIPING DAMAGED DURING CONSTRUCTION SHALL BE REPAIRED WITH MATERIALS TO MATCH EXISTING BY THE CONTRACTOR.

53. PROVIDE AND INSTALL WATER HAMMER ARRESTORS IN THE FOLLOWING LOCATIONS (ONLY NON-FERROUS ARRESTORS MAY BE INSTALLED IN ANY WATER SYSTEM):

- WATER LINES TO LAVATORY HEADERS, WATER CLOSET AND URINAL HEADERS, SERVICE SINKS, KITCHEN SINKS, WASH FOUNTAINS, DRINKING FOUNTAINS, LABORATORIES WITH MEDICAL TYPE FAUCETS AND ON WASH SINKS HAVING 3 OR MORE STATIONS AND ALL OTHER QUICK CLOSING FIXTURE SUCH AS CLOTHES WASHERS, AS CLOSE TO FIXTURE AS POSSIBLE.

- BETWEEN LAST 2 FIXTURES WHEN 3 OR MORE FIXTURES, OTHER THAN THOSE LISTED IN 'A' ABOVE, ARE SERVED BY A COMMON HEADER.

- WHEN ARRESTOR SHALL BE INSTALLED IN WALL OR FURRING, FURNISH WITH AN ACCESS PLATE LARGE ENOUGH TO PERMIT REMOVAL OF ARRESTOR, ACCESS PLATE SHALL BE A MINIMUM OF 2 INCHES LARGER IN EACH DIRECTION THAN ARRESTOR.

54. ALL PIPING INTO STEM WALLS AND FOOTINGS SHALL BE DOUBLE HALF LAP WRAPPED WITH 1/8" THICK "ARMAFLEX" INSULATION. THE CONTRACTOR SHALL ALSO PROVIDE BLOCKED OUT AREAS IN STEM WALL AND FOOTING. ALL PIPING SHALL AVOID THE LOWER 8" OF THE FOOTING.

55. ALL HOT WATER PIPING SHALL BE INSULATED. INSULATION SHALL HAVE A FLAME SPREAD OF NOT MORE THAN 25 AND A SMOKE DENSITY NOT EXCEEDING 50 PER 2016 CMC SEC. 1201.2. SEE SPECIFICATION FOR OTHER REQUIREMENTS.

56. ALL CONNECTIONS TO SITE PIPING SHALL BE DONE BY THE PLUMBING CONTRACTOR.

57. CLEANOUTS SHALL BE PROVIDED PER 2016 CPC SECTION 707.0 & 719.0 AND TO THE FOLLOWING LOCATIONS:

- AT EACH BASE OF ROOF DRAIN DOWNSPOUTS.

- AT EACH BASE OF WASTE STACK.

- AT EVERY 100 FT OF STRAIGHT RUN OF HORIZONTAL PIPING .

- AT EACH AGGREGATE HORIZONTAL CHANGE IN DIRECTION EXCEEDING ONE HUNDRED THIRTY-FIVE (135) DEGREES.

- AT EACH HORIZONTAL DRAINAGE PIPE UPPER TERMINAL.

- ABOVE EACH URINAL.

- BELOW EACH SINK.

58. PROVIDE SEDIMENT TRAP AS CLOSE AS POSSIBLE TO ALL GAS APPLIANCES AND GAS FIRED EQUIPMENTS INLET EXCEPT FOR APPLIANCES LISTED PER 2016 CPC SECTION 1212.8. SEE SEDIMENT TRAP INSTALLATION PER 2016 CPC FIGURE 1212.8.

59. DOMESTIC WATER PIPING AND COMPONENTS SHALL BE PROVIDED AND INSTALLED IN COMPLIANCE WITH CALIFORNIA AB 1953 LEGISLATION, WHICH LIMITS THE ALLOWABLE LEAD CONTENT IN CERTAIN DOMESTIC WATER SYSTEM COMPONENTS.

60. ALL PLUMBING FIXTURES AND FITTINGS SHALL MEET CALGREEN MANDATORY REQUIREMENT OF 20% REDUCED FLOW RATE SPECIFIED IN TABLE 5.303.2.3.

SHEET INDEX

SHEET	DESCRIPTION
P-001	GENERAL NOTES, LEGEND, ABBREVIATIONS AND SHEET INDEX
P-002	SCHEDULES
P-201	FLOOR PLAN
P-601	DETAILS



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GENERAL NOTES,
LEGEND AND
SHEET INDEX

DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

P-001

DATE: NOVEMBER 2, 2018 SHEET ____ OF

PLOT BY: OCTAVIO GONZALEZ PLOT DATE: Nov 02, 2018 - 12:33PM DRAWING NAME: P:\0463\PLUMBING\0463_P002 SCHEDULE.dwg

SCHEDULES

FIXTURE SCHEDULE							
	FIXTURE	MIN. ROUGH-IN SIZES				FLOW RATE	REMARKS
		CW	HW	S OR W	V		
FD-1	FLOOR DRAIN	½"	-	2"	1½"	-	WATTS MODEL FD-1100-L EPOXY COATED CAST IRON DRAIN WITH SQUARE NICKEL-BRONZE HEEL-PROOF TOP, STAINLESS STEEL STRAINER, CLAMPING COLLAR, TRAP PRIMER, CONNECTION AND P-TRAP. REFER TO DETAIL 3/P601.
FS-1	FLOOR SINK	½"	-	2"	1½"	-	WATTS MODEL FS-740, COMPLETE WITH DEEP CAST IRON DRAIN, ACID-RESISTANT PORCELAIN ENAMEL COATED INTERIOR, STAINLESS STEEL FRAME/GRATE, HALF GRATE, TRAP PRIMER CONNECTION AND P-TRAP. REFER TO DETAIL 1/P601.
TP-1	TRAP PRIMER ELECTRONIC TYPE (SINGLE)	½"	-	-	-	-	PPP MINI-PRIME MPB-500, HARDWIRED OPERATED IN RECESSED BOX WITH STAINLESS STEEL COVER. COMPLETE WITH 1/2" COPPER TYPE 'L' PIPE TO RECEPTOR. PROVIDE DISTRIBUTION UNIT AS REQUIRED. ROUGH-IN DIMENSIONS: 12" X 12" X 4" DEEP. COORDINATE POWER REQUIREMENTS WITH ELECTRICAL CONTRACTOR (115V/60HZ/1PH).
EEW-1	EMERGENCY EYE WASH/ SHOWER	-	-	-	-	-	TO BE FURNISHED BY OWNER. INSTALLED BY CONTRACTOR
SS-1	SERVICE SINK	½"	½"	2"	1½"	-	-
NOTES:							
A. ALL FIXTURES SHALL BE PROVIDED WITH MINIMUM ROUGH-IN CONNECTIONS AS INDICATED IN THIS SCHEDULE OR PER MANUFACTURERS RECOMMENDATIONS. THE PLUMBING CONTRACTOR SHALL RUN ALL SERVICE LINES, ROUGH-IN AND MAKE FINAL CONNECTIONS TO ALL FIXTURES. PLUMBING CONTRACTOR SHALL FURNISH AND INSTALL ALL TRIMS, FLUSH VALVES, TAILPIECES, STRAINERS, P-TRAPS, TRAP ARMS, HOT & COLD WATER STOPS AND FAUCETS AS REQUIRED.							
B. OPENINGS IN GRATINGS OR STRAINERS LOCATED IN PEDESTRIAN WAYS OR IN PATH OF TRAVEL (P.O.T.) SHALL NOT ALLOW PASSAGES OF A SPHERE MORE THAN 1/2" DIAMETER. ELONGATED OPENINGS SHALL BE PLACED SO THAT LONG DIMENSION IS PERPENDICULAR TO THE DOMINANT DIRECTION OF TRAVEL IN COMPLIANCE WITH SECTION 11B-302.3.							
C. REFER TO ARCHITECTURAL DRAWINGS FOR ALL FIXTURE MOUNTING HEIGHTS.							

EQUIPMENT

WATER HEATER - GAS FIRED																	
MARK	MANUFACTURER	MODEL	LOCATION	SERVICE	STORAGE CAPACITY (GALS.)	RECOVERY @ 60° F RISE (GPH)	NUMBER OF ELEMENTS	DIMENSIONS			TEMP.		ELECTRICAL			OPER. WEIGHT (LBS)	REMARKS
								WIDTH (IN)	LENGTH (IN)	HEIGHT (IN)	IN (°F)	OUT (°F)	V	W	Ph		
IWH-1	EEMAX SPEC ADVANTAGE WITH PHD	AP14480	BREAK ROOM	EMERGENCY EYE WASH	-	-	-	30	34	40	60	105	480	144	3	450	CAPABLE OF HIGH VOLUME AND HIGH TEMPERATURE APPLICATION AT LOW DUTY CYCLE. FULLY MODULATING- PREDICTIVE CONTROL ALGORITHM AND DIVERSE SAFETY FEATURES ENSURES PRECISE TEMPERATURE CONTROL.

PIPING MATERIALS	
1. DRAIN PIPING SEWER WASTE AND STORM BELOW GRADE:	CAST IRON 'NO-HUB' PIPE CONFORMING TO CISPI 301 AND ASTM A 888 WITH NEOPRENE GASKET AND HEAVY DUTY, SHIELDED, STAINLESS-STEEL 4 OR 6 BAND COUPLINGS. PIPE WRAP ALL UNDERGROUND PIPING.
2. DRAIN PIPING SEWER WASTE AND STORM ABOVE GRADE:	CAST IRON 'NO-HUB' PIPE CONFORMING TO CISPI 301 AND ASTM A 888 WITH NEOPRENE GASKET AND HEAVY DUTY, SHIELDED, STAINLESS-STEEL 4 OR 6 BAND COUPLINGS.
3. VENT PIPING FOR SEWER WASTE/STORM ABOVE GRADE:	CAST IRON 'NO-HUB' PIPE CONFORMING TO CISPI 301 AND ASTM A 888 WITH NEOPRENE GASKET AND STANDARD, SHIELDED, STAINLESS-STEEL 2 OR 4 BAND COUPLINGS.
4. DOMESTIC WATER PIPING BELOW GRADE:	TYPE K' COPPER TUBING, HARD DRAWN CONFORMING TO ASTM B 88, WITH WROUGHT COPPER FITTINGS AND LEAD-FREE BRAZED JOINTS. AVOID UNNECESSARY JOINTS BELOW SLAB. PIPE WRAP ALL UNDERGROUND PIPING.
5. DOMESTIC WATER PIPING ABOVE GRADE:	TYPE 'L' COPPER TUBING, HARD DRAWN CONFORMING TO ASTM B 88, WITH WROUGHT COPPER SOLDER SWEAT FITTINGS AND LEAD-FREE SOLDER JOINTS.
6. CONDENSATE DRAIN PIPING:	TYPE 'L' COPPER TUBING, HARD DRAWN CONFORMING TO ASTM B 88, WITH WROUGHT COPPER SOLDER SWEAT FITTINGS AND LEAD-FREE SOLDER JOINTS. ALL CONDENSATE DRAIN WITHIN BUILDING SHALL BE INSULATED.
7. INSULATION OF DOMESTIC HOT/TEMPERED WATER AND CONDENSATE DRAIN PIPING:	GLASS FIBER PIPE INSULATION WITH FACTORY-APPLIED JACKET CONFORMING TO ASTM C547. 1-INCH THICK FOR PIPE SIZES 1" & SMALLER. 1½-INCH THICK FOR PIPE SIZES 1½" INCHES & LARGER. SEAL ALL JOINTS WITH THE FACTORY-APPLIED, SELF-SEAL LAP AND BUTT STRIPS. JOHNS MANVILLE MICRO-LOK HP OR EQUAL.
10. PIPE PROTECTION: ALL UNDERGROUND METALLIC PIPE WETHER BURIED OR ENCASED SHALL BE WRAPPED WITH ANTI-CORROSIVE 20 MIL PVC TAPE AND PRIMED OR INSTALLED IN 8 MIL POLYETHYLENE SLEEVE CONFORMING TO ASTM D-1248 AND/OR ANSI/AWWA C105/A21.5.	
11. PIPE PROTECTION: PROVIDE NON-CONDUCTING DIELECTRIC CONNECTIONS JOINING DISSIMILAR METALS.	
12. TRACER WIRE: ALL UNDERGROUND PLASTIC PIPE SHALL BE INSTALLED WITH BARE COPPER WIRE. TYPE TW, SIZE AWG#12 PLACED AND SECURED ON TO THE TOP OF THE MAINS AND BRANCHES WITH ALL WIRE TO WIRE CONNECTIONS SOLDERED FOR CONTINUITY.	
13. QUALITY ASSURANCE: THE PIPING SYSTEMS SHALL BE CONSTRUCTED FROM MATERIALS EXTRUDED AND MOLDED USING THE SAME COMPOUND MANUFACTURER.	
14. QUALITY ASSURANCE: BOTH THE PIPE AND FITTINGS SHALL BE MANUFACTURED IN NORTH AMERICA AND MEET OR EXCEED THE REQUIREMENTS SET FORTH BY THE AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM) AND ANSI/NSF STANDARDS 14 AND 61.	



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SCHEDULES

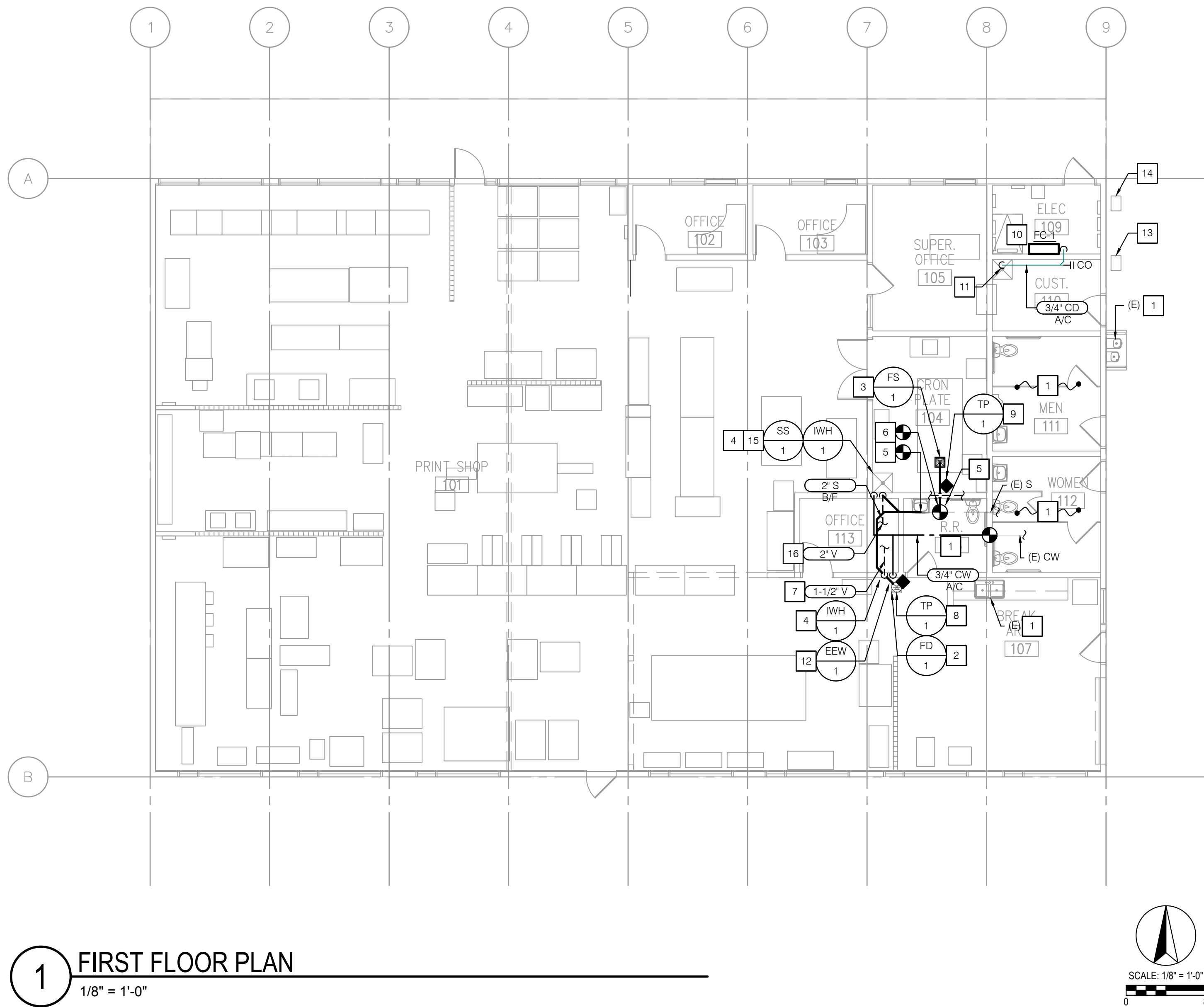
DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

P-002

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

PLOT BY: OCTAVIO GONZALEZ PLOT DATE: NOV 02, 2018 - 12:33PM DRAWING NAME: R:\04653\PLUMBING\04653_P201_FIRST FLOOR PWR.DWG



1 FIRST FLOOR PLAN
1/8" = 1'-0"

- NOTES
- EXISTING PLUMBING FIXTURE TO REMAIN PROTECT IN PLACE. ALL UTILITY SERVICE SHALL REMAIN.
 - PROVIDE 2" WASTE DOWN, 1-1/2" VENT UP TO SERVE FLOOR DRAIN (FD-1). EXTEND SERVICE LINES TO EXISTING UTILITIES IN WALL ABOVE CEILING AND/OR BELOW FLOOR AS REQUIRED. FIELD VERIFY EXACT POINT OF CONNECTION. REFER TO DETAIL 3/P601.
 - PROVIDE 2" WASTE DOWN, 1-1/2" VENT UP TO SERVE FLOOR SINK (FS-1). EXTEND SERVICE LINES TO EXISTING UTILITIES IN WALL ABOVE CEILING AND/OR BELOW FLOOR AS REQUIRED. FIELD VERIFY EXACT POINT OF CONNECTION. REFER TO DETAIL 1/P601.
 - INSTANTANEOUS WATER HEATER (IWH-1)
 - POINT OF CONNECTION OF 3" WASTE TO EXISTING 4" WASTE BELOW FLOOR. FIELD VERIFY EXACT LOCATION IN FIELD.
 - POINT OF CONNECTION OF 1-1/2" VENT TO EXISTING 2" VENT ABOVE CEILING OR IN WALL. FIELD VERIFY EXACT LOCATION IN FIELD.
 - EXTEND 1-1/2" VENT TO EXISTING 2" VENT ABOVE CEILING AS REQUIRED. FIELD VERIFY EXACT LOCATION.
 - PROVIDE 1/2" TRAP PRIMER BELOW FLOOR TO SERVE FLOOR DRAIN (FD-1). FROM TRAP PRIMER (TP-1). REFER TO DETAIL 2/P601.
 - PROVIDE 1/2" TRAP PRIMER BELOW FLOOR TO SERVE FLOOR SINK (FS-1). FROM TRAP PRIMER (TP-1). REFER TO DETAIL 2/P601.
 - MECHANICAL EQUIPMENT (NOT IN PLUMBING SCOPE) REFER TO MECHANICAL DRAWINGS FOR UNIT DESCRIPTION AND INFORMATION.
 - ROUTE 3/4" CD FROM MECHANICAL UNIT TO EXISTING MOP SINK SLOPED AT 1/8" MIN. ALL CONDENSATE PIPING SHALL BE INSULATED. REFER TO DETAIL 4/P601.
 - PROVIDE 2" WASTE, 1-1/2" VEN, AND 3/4" CW TO SERVE EMERGENCY EYEWASH (EEW-1). PROVIDE FULL PORT WATER SHUT-OFF VALVE.
 - CONFIGURE PIPING AS NEEDED FOR THE INSTALLATION OF NEW WATER SUB-METER AT THE SUPPLY PIPE INTO THE BUILDING. METER AND INTEGRATION TO BMS IS PROVIDED BY THE COLLEGE. COORDINATE WITH CONTROLS CONTRACTOR ACCORDINGLY.
 - CONFIGURE PIPING AS NEEDED FOR THE INSTALLATION OF NEW GAS SUB-METER AT THE SUPPLY PIPE INTO THE BUILDING. METER AND INTEGRATION TO BMS IS PROVIDED BY THE COLLEGE. COORDINATE WITH CONTROLS CONTRACTOR ACCORDINGLY.
 - PROVIDE 2" WASTE DOWN, 1-1/2" VENT UP TO SERVE FLOOR SINK (FS-1). EXTEND SERVICE LINES TO EXISTING UTILITIES IN WALL ABOVE CEILING AND/OR BELOW FLOOR AS REQUIRED. FIELD VERIFY EXACT POINT OF CONNECTION. REFER TO DETAIL 1/P601.
 - EXTEND 2" VENT TO EXISTING 2" VENT ABOVE CEILING AS REQUIRED. FIELD VERIFY EXACT LOCATION.



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FIRST FLOOR
PLAN

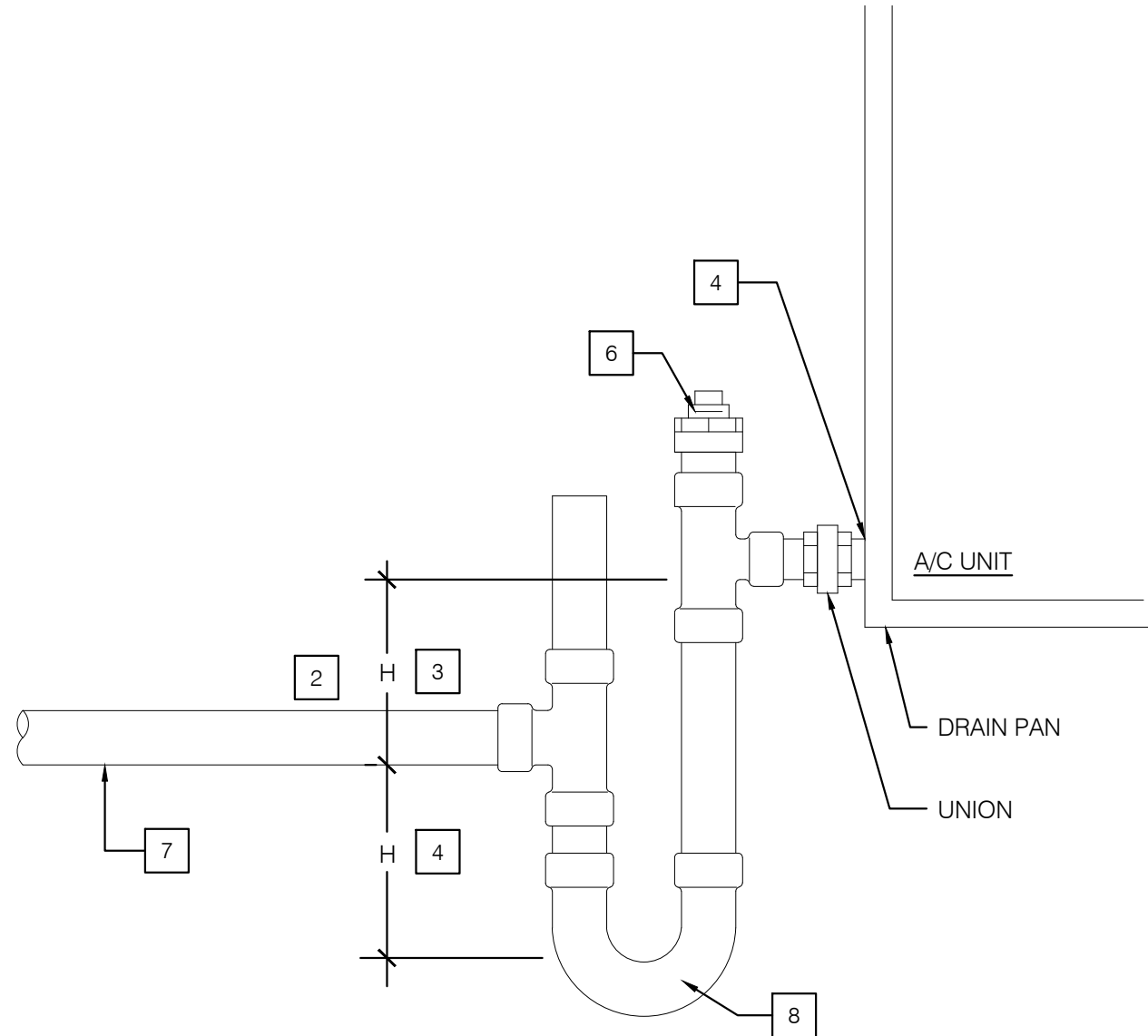
DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

P-201

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

PLOT BY: OCTAVIO GONZALEZ PLOT DATE: NOV 02, 2018 - 10:33PM DRAWING NAME: P:\04653\PLUMBING\04653_P601.DETAIL.DWG



NOTES

- 1

ALL CONDENSATE DRAIN LINES WITHIN BUILDING SHALL BE INSULATED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION 19400, PLUMBING SPECIFICATIONS.
- 2

SEE DRAWING FOR SIZES.
- 3

CONDENSATE PIPE HEIGHT "H" SHALL EQUAL FAN INLET PRESSURE (IN. WC.) PLUS 1.0 INCH. "H" SHALL BE MINIMUM 6 INCHES.
- 4

DEPTH SAME AS NOTE 3.
- 5

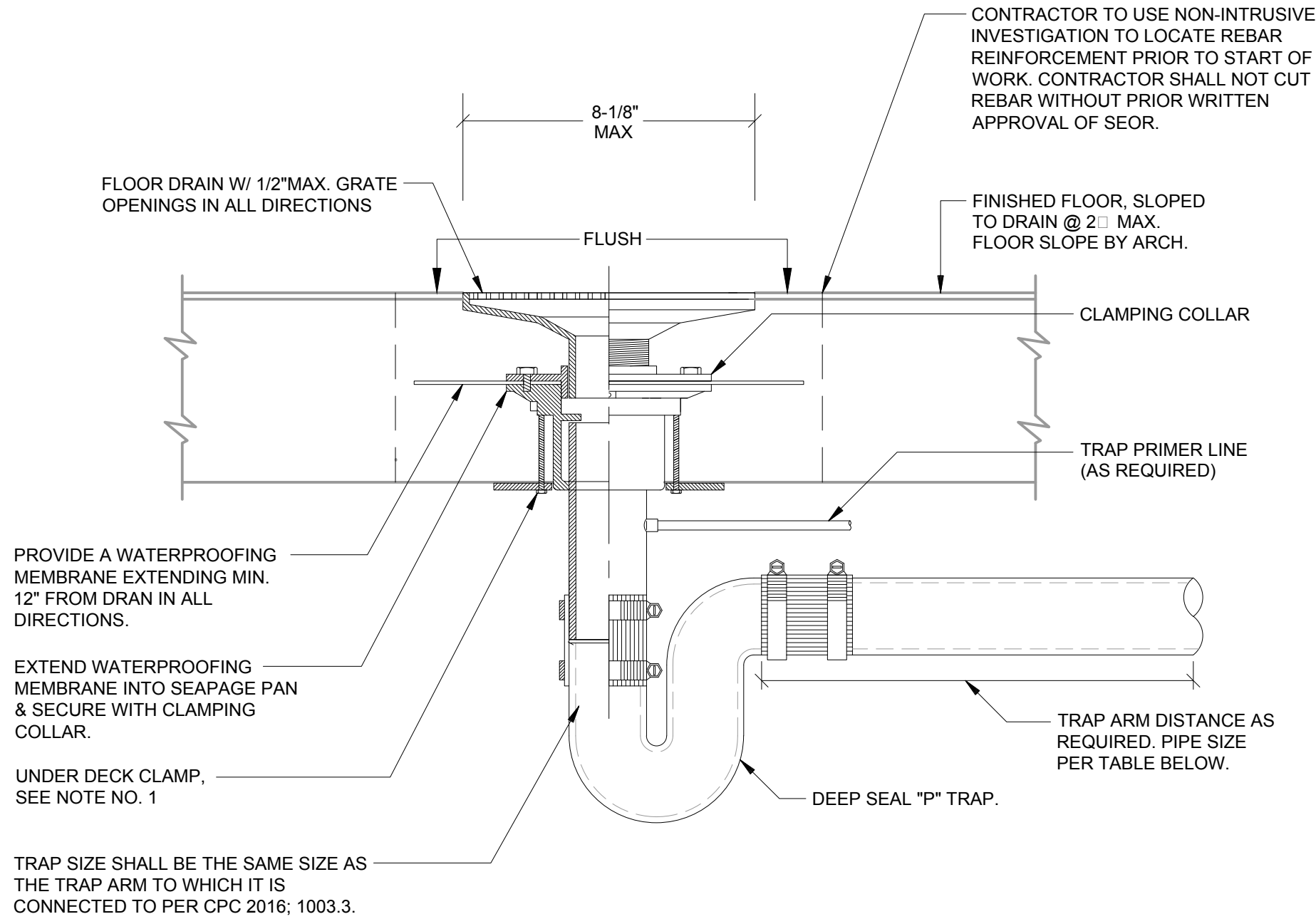
DRAIN LINE SHALL BE AT LEAST THE SAME SIZE AS THE NIPPLE ON THE DRAIN PAN.
- 6

BRASS CLEANOUT PLUG (THREADED)
- 7

FOR CONTINUATION OF PIPING, SEE PLANS.
- 8

TYPE "L" COPPER TUBING WITH WROUGHT COPPER FITTINGS

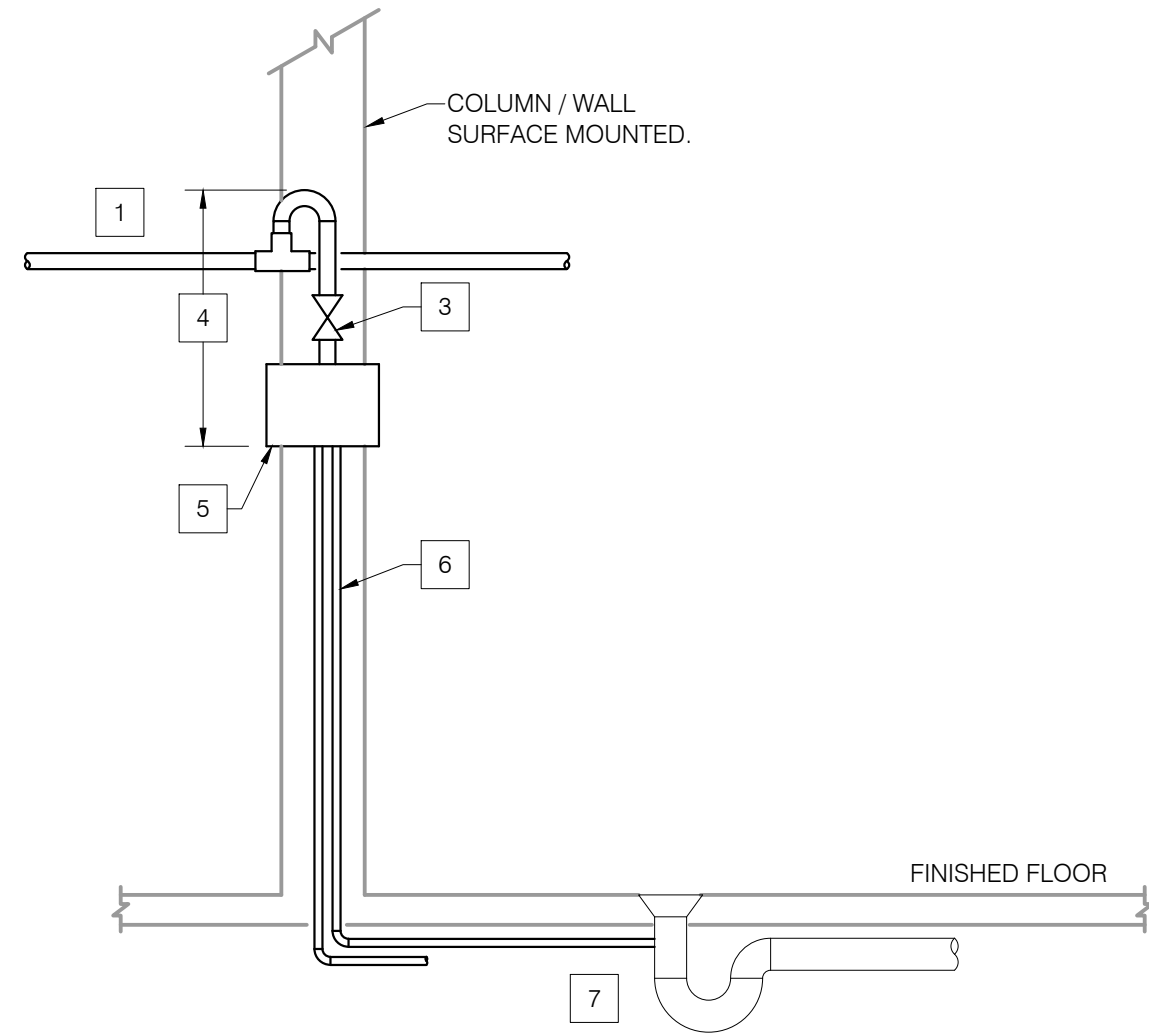
4 CONDENSATE TRAP
NO SCALE



DETAIL NOTES:

1. PROVIDE UNDER DECK CLAMP ON THIN SLAB INSTALLATIONS OF 5" OR LESS (WHERE REQUIRED). SECURE CLAMP TO DRAIN.
2. COORDINATE WITH ARCHITECTURAL DETAIL 26/A7.01 & 30/A7.01 ACCORDINGLY.
3. CONTRACTOR SHALL LOCATE REBAR PRIOR TO CORING (E) SLAB TO AVOID DAMAGE.
4. PROVIDE NON-SHRINK GROUT.

3 FLOOR DRAIN INSTALLATION DETAIL
NO SCALE



NOTES

- 1

MAIN COLD WATER PIPE.
- 2

ACCESSIBLE ACCESS PANEL IF INSTALLED IN WALL.
- 3

PROVIDE TOP CONNECTION FOR 1/2" COLD WATER SUPPLY PIPE WITH SHUT-OFF VALVE FROM MAIN COLD WATER PIPE.
- 4

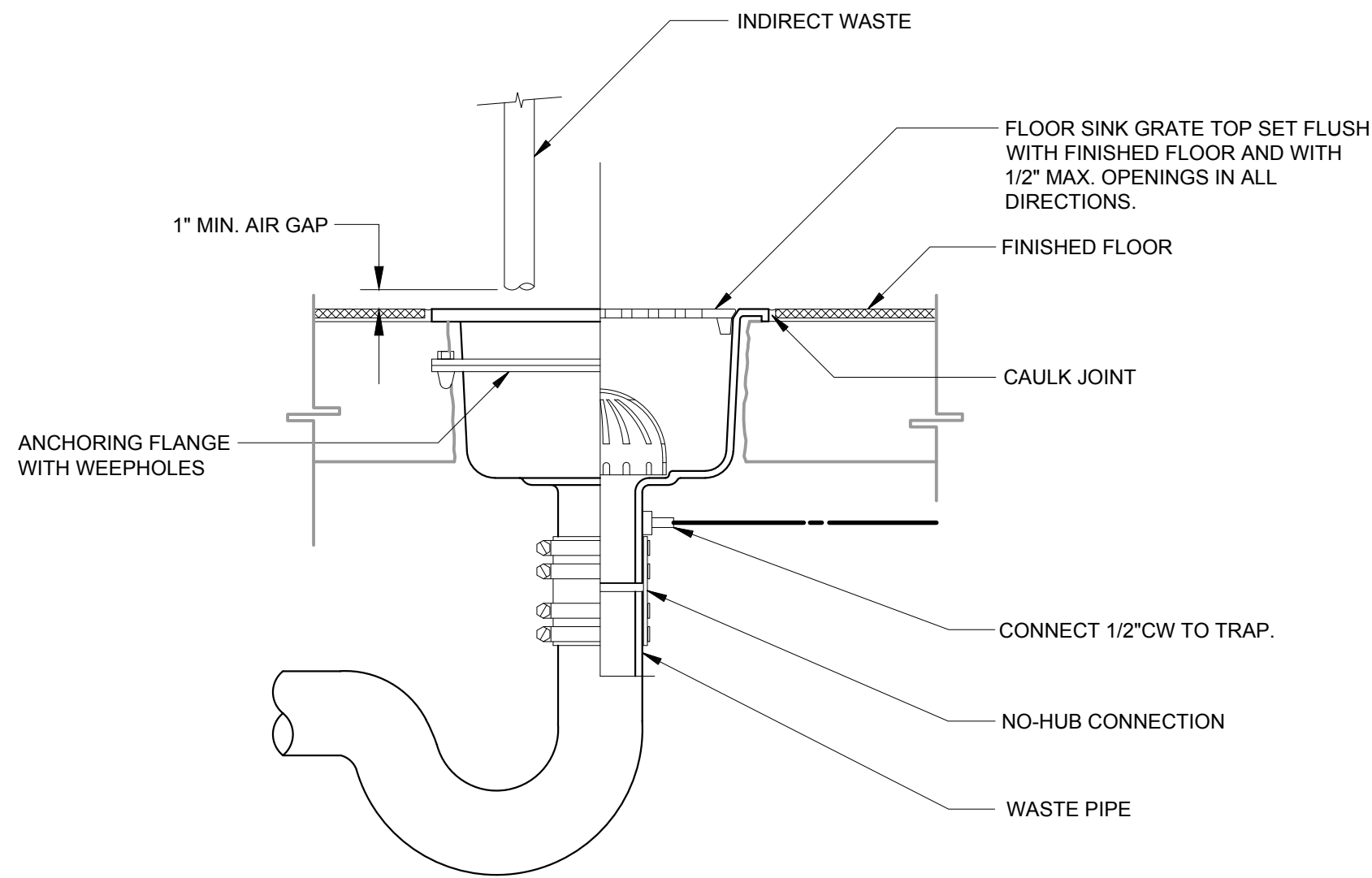
REFER TO MANUFACTURER'S INSTALLATION RECOMMENDATIONS FOR SPECIFIC REQUIREMENTS.
- 5

MI-100 SURFACE MOUNTED ENCLOSURE ELECTRONIC TRAP SEAL PRIMER SYSTEM, MULTI-PORT DISTRIBUTION UNIT.
- 6

COPPER TYPE "L" 1/2" COLD WATER TRAP PRIMER PIPE IN WALL AND ROUTED TO FLOOR DRAINS OR FLOOR SINK. PLUMBING CONTRACTOR SHALL BE FULLY RESPONSIBLE TO PROTECT PIPE WHEN COVERING WITH CONCRETE, ETC.
- 7

FLOOR DRAIN OR FLOOR SINK WITH TRAP.

2 ELECTRONIC TRAP PRIMER
NO SCALE



DETAIL NOTES:

1. PROVIDE UNDER DECK CLAMP ON THIN SLAB INSTALLATIONS OF 5" OR LESS (WHERE REQUIRED). SECURE CLAMP TO DRAIN.
2. COORDINATE WITH ARCHITECTURAL DETAIL 26/A7.01 & 30/A7.01 ACCORDINGLY.
3. CONTRACTOR SHALL LOCATE REBAR PRIOR TO SAW CUTTING (E) SLAB TO AVOID DAMAGE.

1 FLOOR SINK INSTALLATION DETAIL
NO SCALE



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ARCHITECTS

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REVISIONS

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PROJECT OWNER & TITLE

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COMMUNITY COLLEGE DIST.
PRINT SHOP T.I. AT
CRAFTON HILLS
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11711 SAND CANYON ROAD
YUCAIPA, CA 92399

SHEET TITLE

DETAILS

DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

P-601

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

DRAWING NAME: C:\Users\YOUNAHMAD\MySFT\APPDATA\LOCAL\TEMP\A2P\BLS\ILL02\J04-83_LEGEND.dwg PLOT DATE: Nov 09, 2018 - 2:25PM PLOT BY: YOUNAHMAD\MSAEP

LEGEND

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	NOTE CALLOUT		DOWNLIGHT FIXTURE - UPPER CASE LETTER INDICATES LIGHT FIXTURE CALLOUT. LOWER CASE LETTER INDICATES LIGHTING CONTROL ZONE.
	DETAIL CALLOUT - NUMBER ON TOP DENOTES DETAIL NUMBER - NUMBER ON BOTTOM DENOTES SHEET DETAIL IS SHOWN		EMERGENCY DOWNLIGHT FIXTURE FED FROM GENERATOR/ INVERTER/ BATTERY BACKUP
	MECHANICAL EQUIPMENT CALLOUT, SEE MECHANICAL PLANS FOR EXACT LOCATION AND REQUIREMENTS		PENDANT LUMINAIRE - UPPER CASE LETTER INDICATES LIGHT FIXTURE CALLOUT. LOWER CASE LETTER INDICATES LIGHTING CONTROL ZONE.
	SECTION CALLOUT		WALLWASH LIGHT FIXTURE - UPPER CASE LETTER INDICATES LIGHT FIXTURE CALLOUT. LOWER CASE LETTER INDICATES LIGHTING CONTROL ZONE.
	FEEDER CALLOUT		WALL MOUNTED LIGHT FIXTURE - UPPER CASE LETTER INDICATES LIGHT FIXTURE CALLOUT. LOWER CASE LETTER INDICATES LIGHTING CONTROL ZONE.
	EXISTING FEEDER CALLOUT		EMERGENCY WALL MOUNTED LIGHT FIXTURE FED FROM GENERATOR/ INVERTER/ BATTERY BACKUP
	NEW LINework		BOLLARD LUMINAIRE
	EXISTING LINework		POST TOP LUMINAIRE
	DEMOLISHED LINework		POLE MOUNTED LUMINAIRE, SINGLE HEAD
	CONDUIT CONCEALED IN WALL OR ABOVE CEILING		POLE MOUNTED LUMINAIRE, DOUBLE HEAD
	CONDUIT EXPOSED		POLE MOUNTED LUMINAIRE, TRIPLE HEAD
	CONDUIT CONCEALED UNDERGROUND OR BELOW FLOOR		POLE MOUNTED LUMINAIRE, QUAD HEAD
	CONDUIT EMERGENCY		EXIT LIGHT FIXTURE WITH DIRECTIONAL ARROWS AS INDICATED. SHADED SIDE DENOTES NUMBER OF FACES
	MULTI-CHANNEL RACEWAY		JUNCTION BOX
	CONDUIT TURNED UP		PHOTOCELL FOR EXTERIOR APPLICATIONS
	CONDUIT CAPPED		DAYLIGHT SENSOR - CEILING MOUNTED
	BRANCH CIRCUIT HOMERUN TO PANELBOARD AND CIRCUITS AS INDICATED		EMERGENCY RELAY UL 924 COMPLIANT
	3/4" CONDUIT, TICK MARKS INDICATE QUANTITY OF #12 AWG WIRES (UNLESS NOTED OTHERWISE, NO MARKS INDICATES 2#12 & 1#12 GND WIRES) - SMALL MARK DENOTES HOT WIRE - LARGE MARK DENOTES NEUTRAL WIRE - DIAGONAL DENOTES GROUND WIRE		MOTION SENSOR - CEILING MOUNTED
	SWITCH		MOTION SENSOR - CORNER OR WALL MOUNTED
	CIRCUIT BREAKER		MOTION SENSOR WITH AISLE/CORRIDOR LENS - CEILING MOUNTED
	2-WAY SWITCH, TRANSFER SWITCH		COMBINATION MOTION AND DAYLIGHT SENSOR
	FUSE		LIGHTING CONTROL NETWORK DEVICE
	TRANSFORMER		DIGITAL TIMER SWITCH
	GROUND CONNECTION		MOTION SENSOR SWITCH
	MOTOR - SINGLE PHASE FRACTIONAL OR INTEGRAL HORSEPOWER		LOW VOLTAGE SWITCH
	METER		DIMMER MASTER SWITCH
	ELECTRONIC CIRCUIT MONITOR		DIGITAL DIMMING SWITCH
	480V DRAWOUT BREAKER		GRAPHICAL TOUCH SCREEN - LIGHTING CONTROL STATION
	VARIABLE FREQUENCY DRIVE		THERMOSTAT WITH A 3/4" CONDUIT TO ACCESSIBLE CEILING SPACE
	PANEL		LIGHTING CONTROL PANEL - SURFACE MOUNTED
	FUSED DISCONNECT SWITCH		PANELBOARD - RECESSED MOUNTED
	NON-FUSED DISCONNECT SWITCH		PANELBOARD - SURFACE MOUNTED
	COMBINATION STARTER/DISCONNECT SWITCH		DISTRIBUTION PANEL/ BOARD
	SWITCH MOTOR RATED		SINGLE POLE SWITCH, DEVICE SHALL BE MOUNTED +48" MAX AND +36" MIN FROM THE CENTER OF DEVICE:
	SPLICE		SWITCH 3-WAY (48" AFF MAXIMUM)
	TERMINATION		TIMER SWITCH (48" AFF MAXIMUM)
	EXISTING TERMINATION		DUAL SWITCH (48" AFF MAXIMUM)
	2x4 LIGHT FIXTURE - UPPER CASE LETTER INDICATES LIGHT FIXTURE CALLOUT. LOWER CASE LETTER INDICATES LIGHTING CONTROL ZONE.		PUSHBUTTON SWITCH
	2x4 EMERGENCY LIGHT FIXTURE FED FROM GENERATOR/ INVERTER/ BATTERY BACKUP		RECESSED ON WALL SURFACE FLOOR OR CEILING
	2x2 LIGHT FIXTURE - UPPER CASE LETTER INDICATES LIGHT FIXTURE CALLOUT. LOWER CASE LETTER INDICATES LIGHTING CONTROL ZONE.		RECESSED POKE-THROUGH - POWER/TEL/DATA RECESSED FLOOR BOX - POWER/TEL/DATA
	2x2 EMERGENCY LIGHT FIXTURE FED FROM GENERATOR/ INVERTER/ BATTERY BACKUP		20A, 125V DUPLEX RECEPTACLE MOUNTED +15" AFF, UNLESS OTHERWISE NOTED
	LINEAR LIGHT FIXTURE, DIMENSIONS PER PLANS - UPPER CASE LETTER INDICATES LIGHT FIXTURE CALLOUT. LOWER CASE LETTER INDICATES LIGHTING CONTROL ZONE.		20A, 125V QUAD RECEPTACLE MOUNTED +15" AFF, UNLESS OTHERWISE NOTED
	EMERGENCY LINEAR LIGHT FIXTURE, DIMENSIONS PER PLANS - LIGHT FIXTURE FED FROM GENERATOR/ INVERTER/ BATTERY BACKUP		20A, 125V CONTROLLED DUPLEX RECEPTACLE
	LINEAR PENDANT LIGHT FIXTURE, DIMENSIONS PER PLANS - UPPER CASE LETTER INDICATES LIGHT FIXTURE CALLOUT. LOWER CASE LETTER INDICATES LIGHTING CONTROL ZONE.		20A, 125V QUAD RECEPTACLE (HALF) CONTROLLED RECEPTACLE
			SPECIAL RECEPTACLE REFER TO DRAWINGS FOR NEMA CONFIGURATION
			JUNCTION BOX
			RECESSED POKE-THROUGH - POWER/TEL/DATA RECESSED FLOOR BOX - POWER/TEL/DATA
			20A, 125V DUPLEX RECEPTACLE FIRE RATED TYPE
			20A, 125V QUAD RECEPTACLE FIRE RATED TYPE

ABBREVIATIONS

ABBREVIATION	DESCRIPTION	ABBREVIATION	DESCRIPTION
1/C	SINGLE CONDUCTOR	KVA	KILOVOLT-AMPERES
&	AND	KW	KILOWATT
@	AT	LF	LINEAR FEET
A OR AMP	AMPERES	LFMC	LIQUIDTIGHT FLEXIBLE METAL CONDUIT
ABV	ABOVE	LGBV	LARGEST
A.C.	ASPHALT CONCRETE	LIS	LOAD INTERRUPTER SWITCH
AF	AMPERE FUSE RATING	LOC.	LOCATION
AFC	AVAILABLE FAULT CURRENT	LOTO	LOCK-OUT & TAG-OUT
AFF	ABOVE FINISHED FLOOR	LSI	LONG TERM, SHORT TERM, INSTANTANEOUS
AFG	ABOVE FINISH GRADE	LTG	LIGHTING
AIC	AMPERE INTERRUPTING CAPACITY	LV	LOW VOLTAGE
AL	ALUMINUM	M	METER
APPROX.	APPROXIMATE	MAX	MAXIMUM
ARCH.	ARCHITECT; ARCHITECTURAL	MCA	MAXIMUM CIRCUIT AMPACITY
AS	AMPERE SWITCH RATING	MCC	MOTOR CONTROL CENTER
ASCC	AVAILABLE SHORT CIRCUIT CURRENT	MCP	MOTOR CIRCUIT PROTECTOR
ATC	AIR TERMINAL CHAMBER	MFG, MFR	MANUFACTURER
ATO	AUTOMATIC THROW-OVER (SWITCH)	MH	MANHOLE
ATS	AUTOMATIC TRANSFER SWITCH	MI	MECHANICAL INTERLOCK
AUTO	AUTOMATIC	MRCT	MULTI-RATIO CURRENT TRANSFORMER
AUX	AUXILIARY	MIN	MINIMUM
AWG	AMERICAN WIRE GAUGE	MOCP	MAXIMUM OVERCURRENT PROTECTION
BAT	BATTERY	MTD	MOUNTED
BEL	BELOW	MTG	MOUNTING
BKBD	BACKBOARD	MTR	MOTOR
BKR	BREAKER	MTTB	MAIN TELEPHONE TERMINAL BOARD
BLDG	BUILDING	MV	MEDIUM VOLTAGE
B.S.	BARE STRANDED	N	NORTH
C	CONDUIT	NAC	NOTIFICATION APPLIANCE CIRCUIT
CB	CIRCUIT BREAKER	NC	NORMALLY CLOSED
CC	CONSTANT CURRENT	NEC	NATIONAL ELECTRICAL CODE
CEC	CALIFORNIA ELECTRICAL CODE	NF	NON-FUSED
CF	CUBIC FEET	NIC	NOT IN CONTRACT
CKT	CIRCUIT	NIGHT	NIGHT LIGHT- 24HRS ON
CL	CENTER LINE	NO.	NUMBER
CLG	CEILING	OC	ON CENTER
CMU	CONCRETE MASONRY UNIT	OCPD	OVERCURRENT PROTECTIVE DEVICE
C.O.	CONDUIT ONLY WITH PULL WIRE	OD	OUTSIDE DIAMETER
COL	COLUMN	OE	OVERHEAD ELECTRICAL
CP	COMMUNICATION PROCESSOR	OIL	OIL FUSED CUTOUT
CPT	CONTROL POWER TRANSFORMER	OH	OVERHEAD
CR	CONTROL RELAY	OL	OIL LEVER SWITCH
CSFD	COMBINATION SMOKE FIRE DAMPER	P	PROGRAMMABLE AUTOMATION
CT	CURRENT TRANSFORMER	PAC	PROGRAMMABLE AUTOMATION
CW	COLD WATER	PB	PULL BOX
CU	COPPER	PC	PHOTOCELL
DIAG	DIAGRAM	PCB	POLYCHLORINATED BIPHENYL
DIST.	DISTANCE	PDS	PRESSURE DIFFERENTIAL SWITCH
DL	DAMP LOCATION LISTING	PF	POWER FACTOR
DM	DIGITAL METER	PH OR Ø	PHASE
DMM	DIGITAL METER MODULE	PILC	PAPER INSULATED, LEAD COVER
DIST.	DISTRIBUTION PANEL	PIV	POST INDICATING VALVE
DIST.	DISTANCE	PL	PLATE
DWG	DRAWING	PLC	PROGRAMMABLE LOGIC CONTROLLER
DWP	DEPARTMENT OF WATER & POWER	PNL	PANEL
EA	EACH	POC	POINT OF CONNECTION
ECM	ELECTRONIC CIRCUIT MONITOR	PREF.	PREFERRED
ELEC.	ELECTRICAL	PRI.	PRIMARY
EM	EMERGENCY	PVC	POLY-VINYL CHLORIDE
EMH	ELECTRICAL MANHOLE	PWR	POWER
EMT	ELECTRICAL METALLIC TUBING	REC/RECEPT	RECEPTACLE
EPO	EMERGENCY POWER OFF	REQ'D	REQUIRED
EPR	ETHYLENE PROPYLENE RUBBER	RGS	RIGID GALVANIZED STEEL
EQUIP	EQUIPMENT	RMC	RIGID METAL CONDUIT
ER	EXISTING TO BE REMOVED	RBPB	REDUCED PRESSURE BACK FLOW PREVENTER
ERR	EXISTING TO BE RELOCATED AND - RECONNECTED	RM	ROOM
EXIST(E)	EXISTING	RTAC	REAL TIME AUTOMATION CONTROLLER
EXP	EXPLOSION PROOF	SCCR	SHORT CIRCUIT CURRENT RATING
FA	FIRE ALARM	SCE	SOUTHERN CALIFORNIA EDISON
FFE	FINISHED FLOOR ELEVATION	SF	SQUARE FEET
FIN.	FINISH	SHT	SHEET
FIP	FIELD INTERFACE PANEL	SIG.	SIGNAL
FIXT	FIXTURE	SP	SPARE
FLA	FULL LOAD AMPS	SPECS	SPECIFICATIONS
FLR	FLOOR	ST	STREET
FLUOR	FLUORESCENT	STD	STANDARD
FEET	FEET	STP	SHIELDED TWISTED PAIR
FACP	FIRE ALARM CONTROL PANEL	SW	SWITCH
FATC	FIRE ALARM TERMINAL CABINET	SWBD	SWITCHBOARD
FMC	FLEXIBLE METAL CONDUIT	SWGR	SWITCHGEAR
FO	FIBER OPTIC	SWST	SWITCHING STATION
FTG	FOOTING	TB	TERMINAL BLOCK
GEN	GENERATOR	TEL./TELE	TELEPHONE
GFI	GROUND FAULT INTERRUPTER	TMH	TELEPHONE MANHOLE
GFR	GROUND FAULT RELAY	T.O.D.	TOP OF DUCTBANK
GG	GREEN GROUND	T.O.M.	TOP OF MANHOLE
GND	GROUND	TPS	TWISTED SHIELDED PAIR
HOA	HAND-OFF-AUTOMATIC	TRANSF.XFM	TRANSFORMER
HP	HORSEPOWER	TS	TAMPER SWITCH
HT	HEIGHT	TYP	TYPICAL
HTR	HEATER	UG	UNDERGROUND
HZ	HERTZ	UON	UNLESS OTHERWISE NOTED
ICON	INTEGRATED COMMUNICATIONS OPTICAL NETWORK	V	VOLTS
IE	INVERT ELEVATION	VA	VOLT-AMPERES
IED	INTELLIGENT ELECTRONIC DEVICES	VB	VIBRATION SWITCH
IMC	INTERMEDIATE METAL CONDUIT	VFD	VARIABLE FREQUENCY DRIVE
ISC	SHORT CIRCUIT CURRENT	W	WATTS
INCAND	INCADESCENT	W/	WITH
J, JB, J-BOX	JUNCTION BOX	W/O	WITHOUT
KCMIL	THOUSAND CIRCULAR MILS	WCR	WITHSTAND CLOSE-ON RATING
KV	KILOVOLT	WP	WEATHERPROOF
		Z	IMPEDANCE

IN THE EVENT ABBREVIATIONS NOT MENTIONED HEREIN ARE USED, REFERENCE WILL BE MADE TO ANSI Y1.1, MILITARY STANDARD ABBREVIATIONS, AND OTHER STANDARD INDUSTRY CONVENTIONS.

TELECOM LEGEND

SYMBOL	DESCRIPTION
	DATA OUTLET - WALL MOUNTED. PROVIDE AND INSTALL (2) QUANTITY OF CAT 6A CABLES / JACKS TERMINATED IN A 6-PORT FACEPLATE AT 18" AFF. PROVIDE AND INSTALL 4S J.BOX WITH SINGLE GANG MUDRING AND 1-1/4" CONDUIT STUBBED TO ACCESSIBLE CEILING LOCATION. PROVIDE BUSHINGS AND PULLSTRING, U.O.N.
	DATA OUTLET - FLOORBOX. PROVIDE AND INSTALL (4) CAT 6A CABLES /JACKS TERMINATED IN FLOOR BOX, U.O.N.. PROVIDE AND INSTALL 1-1/4" CONDUIT STUBBED TO NEAREST FURRED WALL , ROUTE CONDUIT TO ACCESSIBLE LOCATION ABOVE FINISHED CEILING. PROVIDE BUSHINGS AND PULLSTRING, U.O.N.

GENERAL NOTES

- ALL WORK SHALL COMPLY WITH THE LATEST EDITION OF THE CALIFORNIA ELECTRICAL CODE AND ALL OTHER APPLICABLE FEDERAL AND STATE. WHERE THE CONSTRUCTION DOCUMENTS INDICATE MORE RESTRICTIVE REQUIREMENTS, THE CONSTRUCTION DOCUMENTS SHALL GOVERN BUT THE CONSTRUCTION DOCUMENTS SHALL NOT BE INTERPRETED AS AUTHORITY TO VIOLATE ANY CODE OR REGULATION.
- ALL MATERIALS AND EQUIPMENT SHALL BE NEW AND SHALL BEAR THE UNDERWRITERS' LABEL (UL) AND SHALL BE INSTALLED IN THE MANNER FOR WHICH THEY ARE DESIGNED AND APPROVED.
- THE CONTRACTOR SHALL NOT BORE, NOTCH OR IN ANY WAY CUT INTO ANY STRUCTURAL MEMBER WITHOUT WRITTEN APPROVAL FROM THE ARCHITECT OR STRUCTURAL ENGINEER.
- MECHANICAL, ELECTRICAL AND PLUMBING EQUIPMENT ANCHORAGE NOTES:

ALL MECHANICAL, PLUMBING, AND ELECTRICAL COMPONENTS SHALL BE ANCHORED AND INSTALLED PER THE DETAILS ON THE APPROVED CONSTRUCTION DOCUMENTS. WHERE NO DETAIL IS INDICATED, THE FOLLOWING COMPONENTS SHALL BE ANCHORED OR BRACED TO MEET THE FORCES AND DISPLACEMENT REQUIREMENTS.

- A. ALL PERMANENT EQUIPMENT AND COMPONENTS.
- B. TEMPORARY OR MOVABLE EQUIPMENT THAT IS PERMANENTLY ATTACHED (E.G. HARD WIRED) TO THE BUILDING UTILITY SERVICES SUCH AS ELECTRICITY, GAS OR WATER.

- C. MOVABLE EQUIPMENT WHICH IS STATIONED IN ONE PLACE FOR MORE THAN 8 HOURS AND HEAVIER THAN 400 POUNDS ARE REQUIRED TO BE ANCHORED WITH TEMPORARY ATTACHMENTS.

THE ATTACHMENT OF THE FOLLOWING MECHANICAL AND ELECTRICAL COMPONENT SHALL BE POSITIVELY ATTACHED TO THE STRUCTURE, BUT NEED NOT BE DETAILED ON THE PLANS. THESE COMPONENTS SHALL HAVE FLEXIBLE CONNECTIONS PROVIDED BETWEEN THE COMPONENT AND ASSOCIATED DUCTWORK, PIPING, AND CONDUIT.

- A. COMPONENTS WEIGHING LESS THAN 400 POUNDS AND HAVE A CENTER OF MASS LOCATED 4 FEET OR LESS ABOVE THE ADJACENT FLOOR OR ROOF LEVEL THAT DIRECTLY SUPPORTS THE COMPONENT.

- B. COMPONENTS WEIGHING LESS THAN 20 POUNDS, OR IN THE CASE OF DISTRIBUTED SYSTEMS, LESS THAN 5 POUNDS PER FOOT, WHICH ARE SUSPENDED FROM A ROOF OR FLOOR OR HUNG FROM A WALL.

FOR THOSE ELEMENTS THAT DO NOT REQUIRE DETAILS ON THE APPROVED DRAWINGS, THE INSTALLATION SHALL BE SUBJECT TO THE APPROVAL OF THE STRUCTURAL ENGINEER OF RECORD AND THE STRUCTURAL ENGINEER. THE PROJECT INSPECTOR WILL VERIFY THAT ALL COMPONENTS AND EQUIPMENT HAVE BEEN ANCHORED IN ACCORDANCE WITH ABOVE REQUIREMENTS.

5. PIPING, DUCTWORK, AND ELECTRICAL DISTRIBUTION SYSTEM BRACING NOTES:

PIPING, DUCTWORK, AND ELECTRICAL DISTRIBUTION SYSTEMS SHALL BE BRACED TO COMPLY WITH THE FORCES AND DISPLACEMENTS PRESCRIBED IN LATEST SECTIONS OF CBC AND ASCE.

THE BRACING AND ATTACHMENTS TO THE STRUCTURE SHALL BE DETAILED ON THE APPROVED DRAWINGS OR THEY SHALL COMPLY WITH ONE OF THE OSHPD PRE-APPROVALS (OPA #) AS MODIFIED TO SATISFY ANCHORAGE REQUIREMENTS OF ACI 318, APPENDIX D.

COPIES OF THE MANUAL SHALL BE AVAILABLE ON THE JOBSITE PRIOR TO THE START OF HANGING AND BRACING OF THE PIPE, DUCTWORK, AND ELECTRICAL DISTRIBUTION SYSTEMS.

THE STRUCTURAL ENGINEER OF RECORD SHALL VERIFY THE ADEQUACY OF THE STRUCTURE TO SUPPORT THE HANGER AND BRACE LOADS.

SHEET INDEX

SHEET	DESCRIPTION
E-001	GENERAL NOTES, LEGEND AND SHEET INDEX
E-002	FIRE ALARM, GENERAL NOTES, LEGEND AND SHEET INDEX
E-003	SCHEDULES
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E-211	FIRST FLOOR POWER PLAN
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SHEET TITLE
GENERAL NOTES,
LEGEND AND
SHEET INDEX

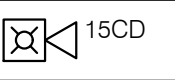
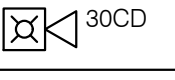
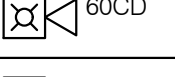
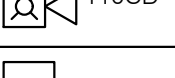
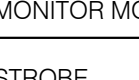
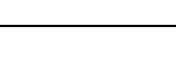
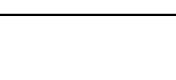
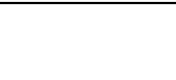
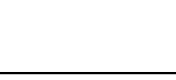
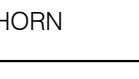
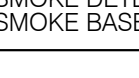
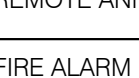
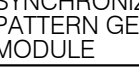
DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

E-001

DATE: NOVEMBER 2, 2018 SHEET ____ OF

FIRE ALARM WIRE SCHEDULE

SYMBOLS	DESCRIPTION	MODEL/CSFM NO.	MOUNTING INFO.
 15CD	HORN/STROBE HORN (TEMPORAL CODED)	GENTEX GEC24-15 7135-0569-122	+96"
 30CD	HORN/STROBE HORN (TEMPORAL CODED)	GENTEX GEC24-30 7135-0569-122	+96"
 60CD	HORN/STROBE HORN (TEMPORAL CODED)	GENTEX GEC24-60 7135-0569-122	+96"
 110CD	HORN/STROBE HORN (TEMPORAL CODED)	GENTEX GEC24-110 7135-0569-122	+96"
 P	MANUAL STATION WITH MONITOR MODULE	FCI MS-2 71509-0694-107	+48"
 15CD	STROBE	GENTEX GES24-15 7125-0569-123	+96"
 30CD	STROBE	GENTEX GES24-30 7125-0569-123	+96"
 60CD	STROBE	GENTEX GES24-60 7125-0569-123	+96"
 110CD	STROBE	GENTEX GES24-110 7125-0569-123	+96"
 FACP	FACP	FCI 7200 7165-0694-174	+48"
 WP	HORN	GENTEX GMH24 7135-0569-119	90"
 2	SMOKE DETECTOR SMOKE BASE		CEILING
 ANN	REMOTE ANNUNCIATOR	FCI KDUJ 7165-0694-174	+48"
	FIRE ALARM AUXILIARY PANEL 'FCPS'	FCI NAC FC-5495 7300-0694-230 WITH BACKBOX	WALL MOUNT AT +48" A.F.F.
	FIRE ALARM TERMINAL CABINET		WALL MOUNT BELOW PANELS
EOL	END OF LINE RESISTOR, 4.7K OHM		
 R	ADDRESSABLE OUTPUT MODULE	FCI AOM-2 7300-0694-178	
 M	ADDRESSABLE MONITOR MODULE	FCI AMM-2 7300-0694-178	
 SN	SYNCHRONIZATION & TEMPORAL PATTERN GENERATOR CONTROL MODULE	GENTEX ZMS4 7300-0569-121	

WIRE LEGEND

WIRE TYPE DESCRIPTION	WIRE DESCRIPTION	USED ON
M	2-CONDUCTOR TWISTED PAIR SOLID CABLE NON-SHIELD #18 AWG WEST PENN 980 FPLR, CSFM #7161-0859-101	SLC ADDRESSABLE DATA CIRCUITS
V	2-CONDUCTOR TWISTED #12 AWG SOLID THHN	NOTIFICATION APPLIANCE CIRCUIT
P	2-CONDUCTOR TWISTED PAIR CABLE SOLID NON-SHIELDED #14 AWG WEST PENN 990 FPLR, CSFM #7161-0859-101	AUXILIARY POWER

EXAMPLE:

25 18 25

NUMBER OF CONDUCTOR PAIRS
WIRE TYPE DESIGNATION
METALLIC RACEWAY/OPEN CABLE/PLENUM CABLE/ETC. (WHERE APPLICABLE)

ABOVE EXAMPLE "2B" MEANS "2 PAIRS OF #14 AWG WIRE"

ALL WIRE AND CABLE TO BE SIGNED, TYPED AND CONDUIT FILL PER CALIFORNIA ELECTRICAL CODE AND MANUFACTURER'S RECOMMENDATION.

WIRE FILL CHART

TRADE SIZE	INTERNAL DIAMETER INCHES	AREA - SQUARE INCHES									
		TOTAL 100%	PERCENT REDUCTION PER NUMBER OF 18AWG TWISTED SHIELDED PAIRS								
			OVER 2 COND. 40%	1	2	3	4	5	6	7	8
1/2	0.622	0.30	0.12	33%	66%	99%	X	X	X	X	X
3/4	0.824	0.53	0.21	19%	38%	57%	76%	95%	X	X	X
1	1.049	0.86	0.34	12%	24%	36%	48%	60%	72%	84%	96%
1 1/4	1.380	1.50	0.60	7%	14%	21%	28%	35%	42%	49%	56%
1 1/2	1.610	2.04	0.82	5%	10%	15%	20%	25	30%	35%	40%
2	2.067	3.36	1.34	3.00%	6%	9%	12%	15%	18%	21%	24%

NOTES:

- ALARM, TROUBLE AND SUPERVISORY SIGNALS FROM ALL INTELLIGENT REPORTING DEVICES SHALL BE ENCODED ON AN NFPA STYLE 6 (CLASS A) SIGNALING LINE CIRCUIT (SLC).
- INITIATION DEVICE CIRCUITS (IDC) SHALL BE WIRED CLASS B (NFPA STYLE B) AS PART OF AN ADDRESSABLE DEVICE CONNECTED BY THE SLC CIRCUIT.
- NOTIFICATION APPLIANCE CIRCUITS (NAC) SHALL BE WIRED CLASS B (NFPA STYLE Y) AS PART OF AN ADDRESSABLE DEVICE CONNECTED BY THE SLC CIRCUIT.
- ON STYLE 6 OR 7 (CLASS A) CONFIGURATIONS A SINGLE GROUND FAULT OR OPEN CIRCUIT ON THE SYSTEM SIGNALING LINE CIRCUIT SHALL NOT CAUSE SYSTEM MALFUNCTION, LOSS OF OPERATING POWER OR THE ABILITY TO REPORT AN ALARM.
- ALARM SIGNALS ARRIVING AT THE FACP SHALL NOT BE LOST FOLLOWING A PRIMARY POWER FAILURE (OR OUTAGE) UNTIL THE ALARM SIGNAL IS PROCESSED AND RECORDED.

APPLICABLE CODES

- PART 1 2013 CALIFORNIA BUILDING STANDARDS ADMINISTRATIVE CODE, TITLE 24 C.C.R.
- PART 2 2013 CALIFORNIA CODE, TITLE 24 C.C.R. (2012 INTERNATIONAL BUILDING CODE OF THE INTERNATIONAL CODE COUNCIL, WITH CALIFORNIA AMENDMENTS)
- PART 3 2013 CALIFORNIA ELECTRICAL CODE, TITLE 24 C.C.R. (2011 NATIONAL ELECTRICAL CODE OF THE NATIONAL FIRE PREVENTION ASSOCIATION, NFPA)
- PART 4 2013 CALIFORNIA MECHANICAL CODE, TITLE 24 C.C.R. (2012 UNIFORM MECHANICAL CODE OF THE INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS, IAPMO)
- PART 5 2013 CALIFORNIA PLUMBING CODE, TITLE 24 C.C.R. (2012 UNIFORM PLUMBING CODE OF THE INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS, IAPMO)
- PART 6 2013 CALIFORNIA ENERGY CODE, TITLE 24 C.C.R.
- PART 7 CURRENTLY VACANT
- PART 8 2013 CALIFORNIA HISTORICAL BUILDING CODE, TITLE 24 C.C.R.
- PART 9 2013 CALIFORNIA FIRE CODE, TITLE 24 C.C.R. (2012 INTERNATIONAL FIRE CODE OF THE INTERNATIONAL CODE COUNCIL)
- PART 10 2013 CALIFORNIA EXISTING BUILDING CODE, TITLE 24 C.C.R. (2012 INTERNATIONAL EXISTING BUILDING CODE OF THE INTERNATIONAL CODE COUNCIL, WITH AMENDMENTS)
- PART 11 2013 CALIFORNIA GREEN BUILDING STANDARDS CODE (CALGREEN), TITLE 24 C.C.R.
- PART 12 2013 CALIFORNIA REFERENCED STANDARDS CODE, TITLE 24 C.C.R.

PARTIAL LIST OF APPLICABLE STANDARDS:
2013 CALIFORNIA BUILDING CODE (FOR SFM) REFERENCED STANDARDS CHAPTER 35

NFPA 13	AUTOMATIC SPRINKLER SYSTEMS (CALIFORNIA AMENDED)	2013 EDITION
NFPA 14	STANDPIPE SYSTEMS (CALIFORNIA AMENDED)	2013 EDITION
NFPA 17	DRY CHEMICAL EXTINGUISHING SYSTEMS	2013 EDITION
NFPA 17A	WET CHEMICAL EXTINGUISHING SYSTEMS	2013 EDITION
NFPA 20	STATIONARY PUMPS	2013 EDITION
NFPA 24	PRIVATE FIRE SERVICE MAINS (CALIFORNIA AMENDED)	2013 EDITION
NFPA 72	NATIONAL FIRE ALARM CODE (CALIFORNIA AMENDED) (NOTE: SEE UL STANDARD 1971 FOR 'VISUAL DEVICES')	2013 EDITION
NFPA 80	FIRE DOOR AND OTHER OPENINGS PROTECTIVES	2013 EDITION
NFPA 253	CRITICAL RADIANT FLUX OF FLOOR COVERING SYSTEMS	2006 EDITION
NFPA 2001	CLEAN AGENT FIRE EXTINGUISHING SYSTEMS	2012 EDITION

DSA NOTES

- ALL WORK SHALL CONFORM TO TITLE 24, 2001 EDITION OF CALIFORNIA CODE OF REGULATIONS (CCR).
- CHANGES TO THE APPROVED DRAWINGS AND SPECIFICATIONS SHALL BE MADE BY AN ADDENDUM OR A CHANGE ORDER APPROVED BY THE DIVISION OF THE STATE ARCHITECT, AS REQUIRED BY SECTION 4-338, PART 1, TITLE 24, CCR.
- A PROJECT INSPECTOR EMPLOYED BY THE DISTRICT (OWNER) AND APPROVED BY THE DIVISION OF THE STATE ARCHITECT SHALL PROVIDE CONTINUOUS INSPECTION OF THE WORK. THE DUTIES OF THE INSPECTOR ARE DEFINED IN SECTION 4-232, PART 1, TITLE 24, CCR.

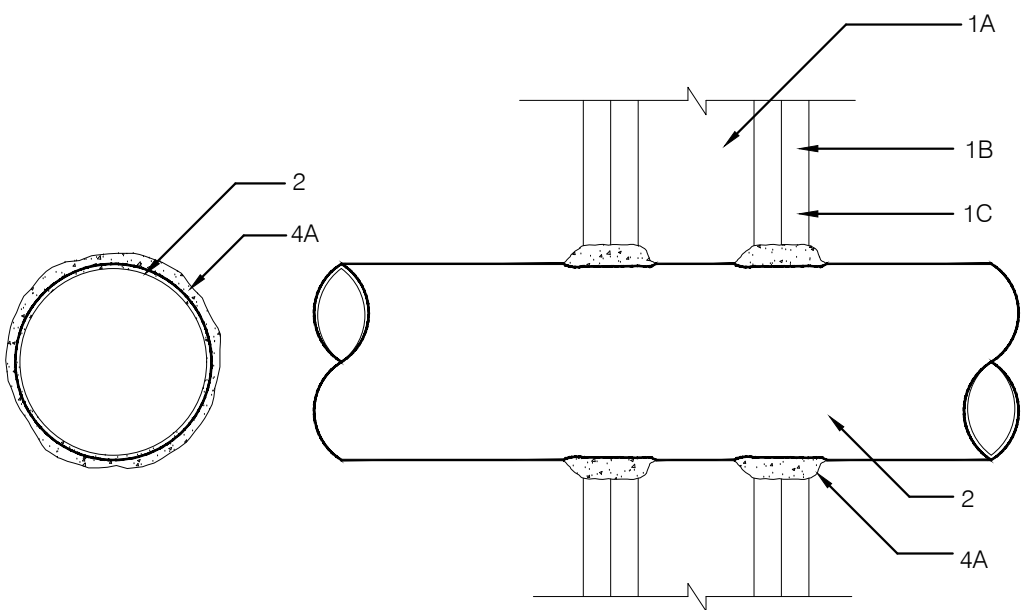
FIRE ALARM SEQUENCE OF OPERATION

OCURRENCE SYSTEM RESPONSE	ACTIVATE SMOKE PULL STATION	ACTIVATE SMOKE DETECTOR	SYSTEM TROUBLE
AUDIBLE ALARM AT PANEL	X	X	
VISUAL ALARM AT PANEL	X	X	X
PANEL INTO ALARM MODE		X	
PANEL INTO TROUBLE MODE			
ACTIVATE AUDIBLE DEVICES	X	X	
ACTIVATE VISUAL STROBE DEVICES	X	X	
AUDIBLE/VISUAL AT ANNUNCIATOR	X	X	X
NOTIFY OFF-SITE MONITOR COMPANY	X	X	X

SCOPE OF WORK

- PROVIDE FIRE ALARM DEVICES FOR A COMPLETE MANUAL ADDRESSABLE FIRE ALARM SYSTEM SUBMITTAL FOR PROPOSED RENOVATION OF PRINT SHOP BUILDING.
- PROVIDE FIRE ALARM SYSTEM DEVICES AS SHOWN IN EQUIPMENT LEGEND, FLOOR PLANS AND SPECIFICATIONS IN THIS CONSTRUCTION DOCUMENT SET. UPON COMPLETION A COMPLETE PRETEST SHALL BE PERFORMED TO VERIFY FUNCTIONALITY. IF THE FUNCTIONALITY IS COMPLETE THEN THE PROPER DOCUMENTATION SHALL BE SUBMITTED TO THE AUTHORITY HAVING JURISDICTION PRIOR TO SCHEDULING A FINAL INSPECTION.
- THE FOLLOWING DOCUMENTATION SHALL BE PROVIDED TO THE OWNER UPON FINAL ACCEPTANCE OF THE SYSTEM:
 - OWNERS MANUAL AND INSTALLATION INSTRUCTION COVERING ALL SYSTEMS EQUIPMENT AND REQUIREMENTS.
 - RECORD SHOP DRAWINGS IN AUTOCAD FORMAT.
 - RECORD COPY OF SITE SPECIFIC SOFTWARE (FOR SOFTWARE BASED).

THROUGH-PENETRATION FIRESTOP SYSTEM



NOTES FOR THIS DETAIL ONLY:

- WALL ASSEMBLY - THE 1,2,3 OR 4 HR FIRE-RATED *MASONARY, CMU WALL OR FLOOR CEILING ASSEMBLY GYPSUM WALL BOARD/STUD WALL ASSEMBLY SHALL BE CONSTRUCTED OF THE MATERIALS AND IN THE MANNER DESCRIBED IN THE INDIVIDUAL WALL OD PARTITION DESIGN IN THE UL FIRE RESISTANCE DIRECTORY AND SHALL INCLUDE THE FOLLOWING CONSTRUCTION FEATURES:
 - STUDS - WALL FRAMING MAY CONSIST OF EITHER WOOD STUDS MAX 2H FIRE RATED ASSEMBLIES OR STEEL CHANNEL STUDS. WOOD STUDS TO CONSIST OF NOMINAL 2 BY 4 IN. LUMBER SPACED 16 IN. OC WITH NOMINAL 2 BY 4 IN. LUMBER END PLATES AND CROSS BRACES. STEEL STUDS TO BE MINIMUM 3- 5/8 IN. WIDE BY 1-3/8 IN. DEEP CHANNELS WITH NOMINAL 1/4 IN. FOLDED BACK RETURN FLANGE EDGES. FORMED FROM MINIMUM 0.025 IN THICK (NO 25 GAUGE) GALVANIZED STEEL. STEEL STUDS CUT 3/4 IN. LESS IN LENGTH THAN ASSEMBLY HEIGHT WITH ENDS NESTING IN AND SECURED TO CHAN- NEL-SHAPED GALVANIZED STEEL FLOOR AND CEILING TRACKS WITH 1/2 IN. LONG TYPE S-12 SELF-DRILLING SELF TAPPING STEEL SCREWS ON BOTH SIDES OF STUDS OR BY WELDING OR BOLTED CONNECTIONS DESIGNED IN ACCORDANCE WITH AISI SPECIFICATIONS. STEEL STUD SPACING NOT TO EXCEED 24 IN. OC
 - WALLBOARD, GYPSUM -NOM 1/2 OR 5/8 IN. THICK 4FT WIDE WITH SQUARE OR TAPERED EDGES. WALLBOARD INSTALLED VERTICALLY ON BOTH SIDES OF STUD FRAMING WITH JOINTS CENTERED OVER STUDS. THE GYPSUM WALLBOARD TYPE, THICKNESS NUMBER OF LAYERS AND SHEET ORIENTATION SHALL BE AS SPECIFIED IN THE INDIVIDUAL U300 - OR U400 - SERIES DESIGN IN THE UL FIRE RESISTANCE DIRECTORY.
 - FASTENERS- WHEN WOOD STUD FRAMING IS EMPLOYED FOR MAX 2 HR FIRE-RATED WALL ASSEMBLY, GYPSUM WALLBOARD ATTACHED TO STUDS WITH CEMENT-COATED NAILS. WHEN STEEL CHANNEL STUD FRAMING IS EMPLOYED, GYPSUM WALLBOARD ATTACHED TO STUDS WITH TYPE S SELF-DRILLING, SELF- TAPPING BUGLE-HEAD STEEL SCREWS. THE TYPE, LENGTH AND SPACING OF FASTENERS SHALL BE AS SPECIFIED IN THE INDIVIDUAL U300 - OR U400 - SERIES DESIGN IN THE UL FIRE RESISTANCE DIRECTORY
 - JOINT TAPE AND COMPOUND- VINYL OR CASEIN, DRY OR PREMIXED JOINT COMPOUND APPLIED IN TWO COATS TO JOINTS AND SCREW OR NAIL HEADS OF OUTER LAYER OF GYPSUM WALLBOARD. PERFORATED PAPER TAPE, 2IN. WIDE, EMBEDDED IN FIRST LAYER OF COMPOUND OVER ALL JOINTS OF OUTER LAYER OF GYPSUM WALLBOARD.
 - PIPE OR CONDUIT- NOM 12 IN. DIAM (OR SMALLER) SCHEDULE 10S (OR HEAVIER) STEEL PIPE, NOM 6 IN. DIAMETER (OR SMALLER) RIGID STEEL CONDUIT, NOM 4 IN. DIAMETER (OR SMALLER) STEEL E.M.T., NOM 4 IN. DIAMETER (OR SMALLER) TYPE L (OR HEAVIER) COPPER PIPE OR NOM 1 IN. DIAM (OR SMALLER) FLEXIBLE STEEL CONDUIT. WHEN COPPER PIPE OR FLEXIBLE STEEL CONDUIT IS USED, MAX F RATING OF FIRESTOP SYSTEM (ITEM 4) IS 2 H. STEEL PIPES OR CONDUITS LARGER THAN NOM. 4 IN. DIAM MAY ONLY BE USED IN WALLS CONSTRUCTED USING STEEL CHANNELS STUDS. A MAX OF ONE PIPE OR CONDUIT IS PERMITTED IN THE FIRESTOP SYSTEM. PIPE OR CONDUIT TO BE INSTALLED NEAR CENTER OF STUD CAVITY WIDTH AND TO BE RIGIDLY SUPPORTED ON BOTH SIDES OF WALL ASSEMBLY.
 - PIPE COVERING -(OPTIONAL) NOM 1 OR 2 IN. THICK HOLLOW CYLINDRICAL HEAVY DENSITY (MIN. 3.5 PCF) GLASS FIBER UNITS JACKETED ON THE OUTSIDE WITH FOIL-SCRM-KRAFT. LONGITUDINAL JOINTS SEALED WITH METAL FASTENERS OR FACTORY-APPLIED SSL. TRANSVERSE JOINTS SEALED WITH METAL FASTENERS OR WITH BUTT STRIP TAPE SUPPLIED WITH THE PRODUCT. SEE PIPE AND EQUIPMENT COVERINGS-MATERIALS (BRGU) CATEGORY IN BUILDING MATERIALS DIRECTORY FOR NAMES OF MANUFACTURES. ANY PIPE COVERING MATERIAL MEETING THE ABOVE SPECIFICATIONS AND BEARING THE UL CLASSIFICATIONS MARKING WITH FLAME SPREAD VALUE 25 OR LESS AND A SMOKE DEVELOPED VALUE OF 50 OR LEDD MAY BE USED.
 - FIRESTOP SYSTEMS-INSTALLED SYMMETRICALLY ON BOTH SIDES OF WALL ASSEMBLY. THE HOURLY F RATING OF THE FIRESTOP SYSTEM IS DEPENDANT UPON THE HOURLY FIRE RATING OF THE FIRESTOP SYSTEM IS DE- PENDANT UPON THE TYPE OR SIZE OF THE PIPE OR CONDUIT, THE ABSENCE OR PRESENCE OF PIPE COVERING (ITEM 3), THE FIRESTOP CONFIGURATION AND THE HOURLY FIRE RATING OF THE WALL ASSEMBLY IN WHICH IT IS INSTALLED. THE FIRESTOP CONFIGURATION (A,B,C OR D) ID DEPENDENT UPON THE SIZE OF THE ANNULAR SPACEBETWEEN THE PIPE OR CONDUIT (OR PIPE COVERING) AND THE PERIMETER OF THE CIRCULAR THROUGH OPENING IN THE GYPSUM WALLBOARD LAYERS AS TABULATED BELOW.

MAX PIPE OR CONDUIT DIAM. IN.	NOM PIPE COVERING THKNS IN.	ANNULAR SPACE IN.	FIRESTOP CONFIG. (A)	F RATING HR.	T RATING HR.
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-

+ WHEN COPPER PIPE IS USED, T RATING IS 0H
(A) INDICATE FIRESTOP CONFIGURATION, AS DESCRIBED IN THE FOLLOWING

 - FILL VOID OR CAVITY MATERIAL-CAULK- CAULK FILL MATERIAL INSTALLED TO COMPLETELY FILL ANNU- LAR SPACE BETWEEN PIPE OR CONDUIT AND GYPSUM WALLBOARD AND WITH A MIN 1/4 IN. DIA BEAD OF CAULK APPLIED TO PERIMETER OF PIPE OR CONDUIT AS IT EGRESS FROM THE WALL. MINNESOTA MINING & MANUFACTURING-TYPES CP-25 S/L, CP-25 N/S, CP-25 W/B U.L. SYSTEM # WL1001
 - REFER TO THE SPECIFICATIONS BOOK FOR ADDITIONAL REQUIREMENTS.
- CONTROL CIRCUITS ARE NON POWER LIMITED. MINIMUM RECOMMENDED WIRE SIZE TO BE DETERMINED BY CIRCUIT LOAD.
 - WIRING SHALL NOT BE LOOPED THROUGH DEVICES UPON TERMINATION. (WIRE MUST BE CUT FOR IN AND OUT RUNS PRIOR TO DEVICE TERMINATION.
 - WHERE SHIELDED CABLE IS USED, THE SHIELD SHALL BE CONTINUOUS AND GROUNDED ONLY AT THE RESPECTIVE CONTROL PANEL.
 - T-TAPPING OR PARALLEL BRANCHING OF NOTIFICATION APPLIANCE DEVICE CIRCUITS IS PERMITTED ON CLASS B CIRCUITS.
 - ELECTRICAL CONTRACTOR IS REQUIRED TO USE: COLOR CODE, WIRE NUMBERS, OR AS SPECIFIED IN THE PROJECT SPECIFICATIONS ON ALL CIRCUITS AND SHALL BE CONTINUOUS. OTHERWISE, NO FINAL CONNECTIONS OR TESTING SHALL BE PERFORMED. IF WIRE COLOR CODING IS USED, GREEN WILL BE USED FOR GROUND BONDING ONLY.
 - POINT AND COMMON ANNUNCIATION AND T-TAPPING PROHIBITED.
 - ALL WIRING, INITIATING DEVICES AND ANNUNCIATOR PANELS SHALL BE SUPERVISED TO THE PRINCIPAL POINT OF ANNUNCIATION, (FIRE ALARM CONTROL PANEL(S) TO SUPERVISE ANNUNCIATOR PANEL(S), SUB-PANEL(S), ALL CIRCUITS AND INITIATING DEVICES).
 - FIRE ALARM SIGNAL SHALL MEET ANSI S3.41, AUDIBLE EMERGENCY EVACUATION SIGNAL (TEMPORAL PATTERN).
 - AUDIBILITY OF ALARM SHALL BE NOT LESS THAN 15DB ABOVE AMBIENT SOUND THROUGHOUT THE AREA OF ALARM.
 - ALL STROBE APPLIANCES SHALL BE SYNCHRONIZED IN ACCORDANCE WITH NATIONAL FIRE ALARM CODE (NFPA 72). REFERENCE APPLICABLE EDITIONS UNDER 'APPLICABLE CODES & REGULATIONS'.
 - STROBE APPLIANCE LOCATIONS ARE BASED ON 10 FOOT CEILING HEIGHTS AND ARE INSTALLED IN ACCORDANCE WITH NATIONAL FIRE ALARM CODE (NFPA 72) UNLESS OTHERWISE NOTED. REFERENCE APPLICABLE EDITIONS UNDER 'APPLICABLE CODES & REGULATIONS'.
 - WALL-MOUNTED STROBE AND HORN/STROBE APPLIANCES SHALL BE MOUNTED A MINIMUM OF 80 INCHES ABOVE FINISHED FLOOR OR 6 INCHES MINIMUM BELOW THE CEILING, (WHICH EVER IS LOWER). MEASUREMENT ARE TO BE TAKEN FROM BOTTOM OF STROBE.
 - PHOTOELECTRIC DETECTORS SHALL NOT BE IN DIRECT AIR STREAM SUPPLY AIR OUTLETS.
 - REFER TO RESPECTIVE CATALOG CUT SHEETS FOR ELECTRICAL MOUNTING HARDWARE.
 - THE USE OF OTHER THAN SIEMENS DETECTORS AND BASES WITH SIEMENS CONTROL EQUIPMENT WILL BE CONSIDERED A MISAPPLICATION OF SIEMENS EQUIPMENT AND SUCH, VOIDS ALL WARRANTIES EITHER EXPRESSED OR IMPLIED WITH REGARDS TO LOSS, DAMAGE, LIABILITIES AND/OR SERVICE PROBLEMS.
 - ALL DEVICES OF THE FIRE ALARM SYSTEM SHALL BE APPROVED AND LISTED BY THE CALIFORNIA STATE FIRE MARSHAL.
 - AUDIBILITY WILL BE DETERMINED BY THE FIELD FIRE MARSHAL.
 - ALL FIRE ALARM CIRCUITS SHALL BE LABELED AT CONNECTIONS AND AT JUNCTION BOXES.
 - DUCT SMOKE DETECTORS SHALL BE TESTED FOR DUCT VELOCITY AND PRESSURE DIFFERENTIAL IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS.
 - DIFFERENTIAL PRESSURE SWITCHES SHALL BE SUPPLIED AND INSTALLED BY A LICENSED MECHANICAL CONTRACTOR. THE ELECTRICAL CONNECTION TO THE DIFFERENTIAL PRESSURE SWITCH SHALL BE MADE BY SIEMENS.
 - SIEMENS EQUIPMENT IS BOTH UNDERWRITERS LABORATORIES (UL) AND CALIFORNIA STATE FIRE MARSHAL (CSFM) LISTED FOR POWER LIMITED INSTALLATION.
 - UNLESS OTHERWISE NOTED ALL WIRING AND INSTALLATION METHODS SHALL CONFORM TO CALIFORNIA ELECTRICAL CODE (CEC), ARTICLE 760. SEE APPLICABLE EDITION UNDER 'APPLICABLE CODES & REGULATIONS'.
 - ALL WIRE CONDUCTORS SHALL BE POWER LIMITED COPPER WIRING AND INSTALLED WITHIN A METALLIC RACEWAY.
 - PER SPECIFICATION CONDUIT RISERS SHALL BE INSTALLED INSIDE A TWO HOUR FIRE RATED ENCLOSURE PROVIDED BY OTHERS. HORIZONTAL OFFSET CONDUITS AND JUNCTION BOXES SHALL BE PROTECTED BY TWO HOUR FIRE RATED ENCLOSURES PROVIDED BY OTHERS.
 - ALL RACEWAY RUNS INDICATED WITHIN THIS DRAWING PACKAGE ARE SHOWN DIAGRAMMICALY AND ARE FOR CIRCUITING PURPOSES ONLY. ALL RUNS SHOWN SHOULD NOT SERVE IN ANY WAY AS AN ACTUAL ROUTING GUIDE FOR INSTALLATION OF RACEWAYS. EXACT INSTALL LOCATION SHALL BE FIELD DETERMINED.
 - ADDITIONAL JUNCTION BOXES NOT SHOWN MAY BE REQUIRED TO ACCOMMODATE PROPER RACEWAY INSTALLATIONS. IT IS THE ELECTRICAL CONTRACTORS RESPONSIBILITY TO DETERMINE THE NECESSARY AMOUNT OF JUNCTION BOXES REQUIRED.
 - SUBMITTED DRAWING PACKAGE MUST BE REVIEWED BY COLLEGE REPRESENTATIVE AND ONE COPY OF THE REVIEWED DRAWING AND SUBMITTAL MUST BE RETURNED TO SIEMENS BEFORE ANY EQUIPMENT IS SHIPPED OR INSTALLED. CUSTOM ANNUNCIATORS WILL NOT BE FABRICATED UNTIL WRITTEN APPROVAL OF LAYOUT AND/OR ARTWORK IS RECEIVED.
 - NOTICE: DO NOT APPLY POWER TO CONTROL PANEL(S) UNTIL A SIEMENS SERVICE TECHNICIAN HAS CHECKED THE SYSTEM INSTALLATIONS, UPON SATISFACTORY COMPLETION OF HIS INSPECTION, POWER WILL BE APPLIED TO THE CONTROL PANEL(S). SIEMENS ASSUMES NO LIABILITY FOR ANY DAMAGE TO THE EQUIPMENT SUPPLIED IF POWER IS APPLIED TO THE CONTROL PANEL(S) PRIOR TO INSPECTION OF THE INSTALLATION BY SIEMENS TECHNICIAN.
 - FOR INSPECTION AND OR TESTING THE FIRE MARSHAL SHALL BE NOTIFIED FOR SCHEDULING AN APPOINTMENT.
 - A CERTIFICATE OF COMPLIANCE SHALL BE PREPARED BY THE INSTALLER AND GIVEN TO THE FIRE MARSHAL UPON COMPLETION OF THE INSTALLATION.
 - ANY DISCREPANCIES BETWEEN THE DRAWINGS AND THE CODE OR RECOGNIZED STANDARDS SHALL BE BROUGHT TO THE ATTENTION OF THE INSPECTOR OF RECORD. THE STRICTER REQUIREMENT WILL PREVAIL.
 - A STAMPED SET OF APPROVED FIRE ALARM PLANS SHALL BE ON THE JOB SITE AND USED FOR INSTALLATION. ANY DEVIATION FROM APPROVED PLANS, INCLUDING THE SUBSTITUTION OF DEVICES SHALL BE APPROVED BY THE FIRE MARSHAL.
 - UPON COMPLETION OF THE FIRE ALARM SYSTEM, A SATISFACTORY TEST OF THE ENTIRE SYSTEM SHALL BE MADE IN THE PRESENCE OF THE FIRE MARSHAL.
 - UNLESS SPECIFICALLY SHOWN ON THESE PLANS NO STRUCTURAL MEMBERS SHALL BE CUT, DRILLED NOR NOTCHED WITHOUT PRIOR WRITTEN AUTHORIZATION FROM THE STRUCTURAL ENGINEER AND THE DISTRICT STRUCTURAL ENGINEER FROM THE DIVISION OF THE STATE ARCHITECT.
 - REFER TO THE SPECIFICATIONS BOOK FOR ADDITIONAL REQUIREMENTS.

GENERAL NOTES

- CONTROL CIRCUITS ARE NON POWER LIMITED. MINIMUM RECOMMENDED WIRE SIZE TO BE DETERMINED BY CIRCUIT LOAD.
- WIRING SHALL NOT BE LOOPED THROUGH DEVICES UPON TERMINATION. (WIRE MUST BE CUT FOR IN AND OUT RUNS PRIOR TO DEVICE TERMINATION.
- WHERE SHIELDED CABLE IS USED, THE SHIELD SHALL BE CONTINUOUS AND GROUNDED ONLY AT THE RESPECTIVE CONTROL PANEL.
- T-TAPPING OR PARALLEL BRANCHING OF NOTIFICATION APPLIANCE DEVICE CIRCUITS IS PERMITTED ON CLASS B CIRCUITS.
- ELECTRICAL CONTRACTOR IS REQUIRED TO USE: COLOR CODE, WIRE NUMBERS, OR AS SPECIFIED IN THE PROJECT SPECIFICATIONS ON ALL CIRCUITS AND SHALL BE CONTINUOUS. OTHERWISE, NO FINAL CONNECTIONS OR TESTING SHALL BE PERFORMED. IF WIRE COLOR CODING IS USED, GREEN WILL BE USED FOR GROUND BONDING ONLY.
- POINT AND COMMON ANNUNCIATION AND T-TAPPING PROHIBITED.
- ALL WIRING, INITIATING DEVICES AND ANNUNCIATOR PANELS SHALL BE SUPERVISED TO THE PRINCIPAL POINT OF ANNUNCIATION, (FIRE ALARM CONTROL PANEL(S) TO SUPERVISE ANNUNCIATOR PANEL(S), SUB-PANEL(S), ALL CIRCUITS AND INITIATING DEVICES).
- FIRE ALARM SIGNAL SHALL MEET ANSI S3.41, AUDIBLE EMERGENCY EVACUATION SIGNAL (TEMPORAL PATTERN).
- AUDIBILITY OF ALARM SHALL BE NOT LESS THAN 15DB ABOVE AMBIENT SOUND THROUGHOUT THE AREA OF ALARM.
- ALL STROBE APPLIANCES SHALL BE SYNCHRONIZED IN ACCORDANCE WITH NATIONAL FIRE ALARM CODE (NFPA 72). REFERENCE APPLICABLE EDITIONS UNDER 'APPLICABLE CODES & REGULATIONS'.
- STROBE APPLIANCE LOCATIONS ARE BASED ON 10 FOOT CEILING HEIGHTS AND ARE INSTALLED IN ACCORDANCE WITH NATIONAL FIRE ALARM CODE (NFPA 72) UNLESS OTHERWISE NOTED. REFERENCE APPLICABLE EDITIONS UNDER 'APPLICABLE CODES & REGULATIONS'.
- WALL-MOUNTED STROBE AND HORN/STROBE APPLIANCES SHALL BE MOUNTED A MINIMUM OF 80 INCHES ABOVE FINISHED FLOOR OR 6 INCHES MINIMUM BELOW THE CEILING, (WHICH EVER IS LOWER). MEASUREMENT ARE TO BE TAKEN FROM BOTTOM OF STROBE.
- PHOTOELECTRIC DETECTORS SHALL NOT BE IN DIRECT AIR STREAM SUPPLY AIR OUTLETS.
- REFER TO RESPECTIVE CATALOG CUT SHEETS FOR ELECTRICAL MOUNTING HARDWARE.
- THE USE OF OTHER THAN SIEMENS DETECTORS AND BASES WITH SIEMENS CONTROL EQUIPMENT WILL BE CONSIDERED A MISAPPLICATION OF SIEMENS EQUIPMENT AND SUCH, VOIDS ALL WARRANTIES EITHER EXPRESSED OR IMPLIED WITH REGARDS TO LOSS, DAMAGE, LIABILITIES AND/OR SERVICE PROBLEMS.
- ALL DEVICES OF THE FIRE ALARM SYSTEM SHALL BE APPROVED AND LISTED BY THE CALIFORNIA STATE FIRE MARSHAL.
- AUDIBILITY WILL BE DETERMINED BY THE FIELD FIRE MARSHAL.
- ALL FIRE ALARM CIRCUITS SHALL BE LABELED AT CONNECTIONS AND AT JUNCTION BOXES.
- DUCT SMOKE DETECTORS SHALL BE TESTED FOR DUCT VELOCITY AND PRESSURE DIFFERENTIAL IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS.
- DIFFERENTIAL PRESSURE SWITCHES SHALL BE SUPPLIED AND INSTALLED BY A LICENSED MECHANICAL CONTRACTOR. THE ELECTRICAL CONNECTION TO THE DIFFERENTIAL PRESSURE SWITCH SHALL BE MADE BY SIEMENS.
- SIEMENS EQUIPMENT IS BOTH UNDERWRITERS LABORATORIES (UL) AND CALIFORNIA STATE FIRE MARSHAL (CSFM) LISTED FOR POWER LIMITED INSTALLATION.
- UNLESS OTHERWISE NOTED ALL WIRING AND INSTALLATION METHODS SHALL CONFORM TO CALIFORNIA ELECTRICAL CODE (CEC), ARTICLE 760. SEE APPLICABLE EDITION UNDER 'APPLICABLE CODES & REGULATIONS'.
- ALL WIRE CONDUCTORS SHALL BE POWER LIMITED COPPER WIRING AND INSTALLED WITHIN A METALLIC RACEWAY.
- PER SPECIFICATION CONDUIT RISERS SHALL BE INSTALLED INSIDE A TWO HOUR FIRE RATED ENCLOSURE PROVIDED BY OTHERS. HORIZONTAL OFFSET CONDUITS AND JUNCTION BOXES SHALL BE PROTECTED BY TWO HOUR FIRE RATED ENCLOSURES PROVIDED BY OTHERS.
- ALL RACEWAY RUNS INDICATED WITHIN THIS DRAWING PACKAGE ARE SHOWN DIAGRAMMICALY AND ARE FOR CIRCUITING PURPOSES ONLY. ALL RUNS SHOWN SHOULD NOT SERVE IN ANY WAY AS AN ACTUAL ROUTING GUIDE FOR INSTALLATION OF RACEWAYS. EXACT INSTALL LOCATION SHALL BE FIELD DETERMINED.
- ADDITIONAL JUNCTION BOXES NOT SHOWN MAY BE REQUIRED TO ACCOMMODATE PROPER RACEWAY INSTALLATIONS. IT IS THE ELECTRICAL CONTRACTORS RESPONSIBILITY TO DETERMINE THE NECESSARY AMOUNT OF JUNCTION BOXES REQUIRED.
- SUBMITTED DRAWING PACKAGE MUST BE REVIEWED BY COLLEGE REPRESENTATIVE AND ONE COPY OF THE REVIEWED DRAWING AND SUBMITTAL MUST BE RETURNED TO SIEMENS BEFORE ANY EQUIPMENT IS SHIPPED OR INSTALLED. CUSTOM ANNUNCIATORS WILL NOT BE FABRICATED UNTIL WRITTEN APPROVAL OF LAYOUT AND/OR ARTWORK IS RECEIVED.
- NOTICE: DO NOT APPLY POWER TO CONTROL PANEL(S) UNTIL A SIEMENS SERVICE TECHNICIAN HAS CHECKED THE SYSTEM INSTALLATIONS, UPON SATISFACTORY COMPLETION OF HIS INSPECTION, POWER WILL BE APPLIED TO THE CONTROL PANEL(S). SIEMENS ASSUMES NO LIABILITY FOR ANY DAMAGE TO THE EQUIPMENT SUPPLIED IF POWER IS APPLIED TO THE CONTROL PANEL(S) PRIOR TO INSPECTION OF THE INSTALLATION BY SIEMENS TECHNICIAN.
- FOR INSPECTION AND OR TESTING THE FIRE MARSHAL SHALL BE NOTIFIED FOR SCHEDULING AN APPOINTMENT.
- A CERTIFICATE OF COMPLIANCE SHALL BE PREPARED BY THE INSTALLER AND GIVEN TO THE FIRE MARSHAL UPON COMPLETION OF THE INSTALLATION.
- ANY DISCREPANCIES BETWEEN THE DRAWINGS AND THE CODE OR RECOGNIZED STANDARDS SHALL BE BROUGHT TO THE ATTENTION OF THE INSPECTOR OF RECORD. THE STRICTER REQUIREMENT WILL PREVAIL.
- A STAMPED SET OF APPROVED FIRE ALARM PLANS SHALL BE ON THE JOB SITE AND USED FOR INSTALLATION. ANY DEVIATION FROM APPROVED PLANS, INCLUDING THE SUBSTITUTION OF DEVICES SHALL BE APPROVED BY THE FIRE MARSHAL.
- UPON COMPLETION OF THE FIRE ALARM SYSTEM, A SATISFACTORY TEST OF THE ENTIRE SYSTEM SHALL BE MADE IN THE PRESENCE OF THE FIRE MARSHAL.
- UNLESS SPECIFICALLY SHOWN ON THESE PLANS NO STRUCTURAL MEMBERS SHALL BE CUT, DRILLED NOR NOTCHED WITHOUT PRIOR WRITTEN AUTHORIZATION FROM THE STRUCTURAL ENGINEER AND THE DISTRICT STRUCTURAL ENGINEER FROM THE DIVISION OF THE STATE ARCHITECT.
- REFER TO THE SPECIFICATIONS BOOK FOR ADDITIONAL REQUIREMENTS.



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SAN BERNARDINO
COMMUNITY COLLEGE DIST.

PRINT SHOP T.I. AT
CRAFTON HILLS
COLLEGE BL 14
11711 SAND CANYON ROAD
YUCAIPA, CA 92399

SHEET TITLE

FIRE ALARM
GENERAL NOTES,
LEGEND AND
SHEET INDEX

DRAWN BY: MH/OP JOB NUMBER: 18116.03

SHEET NO.

E-002

DATE: NOVEMBER 2, 2018 SHEET ____ OF

DRAWING NAME: R:\0463\ELECTRICAL\0463_E003_SCHEDULES.DWG
PLOT DATE: Nov 09, 2018 - 2:25PM
PLOT BY: KHAIRIAD WAFAF

PANEL: P1		(NEW)								
LOCATION :		VOLTAGE/PHASE : 208Y/120V, 3Ø,4W		FED FROM : PANEL 'BS'						
FLOOR : FIRST		BUS AMPS : 225A		RATING: 10KAIC						
MOUNTING : SURFACE		MAIN BREAKER : 225A/3P, 100%RATED								
LOADS	SEE NOTE	* OUTLETS LTG REC MISC	VOLT-AMPS A B C	BKRV POLE	A B C	BKRV POLE	VOLT-AMPS A B C	OUTLETS LTG REC MISC	* SEE NOTE	LOADS
COLLATER			1,000	1	20/1	2	3,561			COLLATER
COLLATER			1,000	3	20/1	4	3,561			-
COLLATER			1,000	5	20/1	6	3,561	3,561		COLLATER
CONVEYOR			180	7	20/2	8	3,561			-
-			180	9	-	40/2	10	3,561		COLLATER
SPARE				11	20/1	12		3,561		-
PAPER CUTTER			1,765	13	20/3	14	1,000			ROLLEN NUMBERING MACHINE
-			1,765	15	-	20/1	16	1,440		CREASER
-			1,765	17	-	20/1	18	1,000		MICROWAVE
COLLATER ATTACHMENT			1,000	19	20/1	20	1,000			MICROWAVE
STRAPPING			840	21	20/1	22	1,000	1,000		REFRIGERATOR
HOLE PUNCH			1,200	23	20/3	24		840		STAPLER
-			1,200	25	-	20/1	26	960		PRINTING PRESS CONSOLE
-			1,200	27	-	20/1	28	960		PRINTING PRESS CONSOLE
PRINTING PRESS			4,323	29	50/3	30				SPARE
-			4,323	31	-	20/1	32			SPARE
-			4,323	33	-	20/1	34			SPARE
PRINTING PRESS			4,323	35	50/3	36		1,040		AIR COMPRESSOR
-			4,323	37	-	20/1	40	1,040		-
-			4,323	39	-	20/1	40			SPARE
SPARE				41	20/1	42				SPARE
NOTES: * "L" DENOTES LONG CONTINUOUS LOAD										
TOTAL OA = 24913 VOLT-AMPS		207.6 AMPS								
TOTAL OB = 24153 VOLT-AMPS		201.3 AMPS								
TOTAL OC = 22613 VOLT-AMPS		188.4 AMPS								
TOTAL PANEL = 71,679 VA @ 208V, 3Ø = 199 AMPS										

PANEL: P2		(NEW)								
LOCATION :		VOLTAGE/PHASE : 208Y/120V, 3Ø,4W		FED FROM : PANEL 'BS'						
FLOOR : FIRST		BUS AMPS : 225A		RATING: 10KAIC						
MOUNTING : SURFACE		MAIN BREAKER : 225A/3P								
LOADS	SEE NOTE	* OUTLETS LTG REC MISC	VOLT-AMPS A B C	BKRV POLE	A B C	BKRV POLE	VOLT-AMPS A B C	OUTLETS LTG REC MISC	* SEE NOTE	LOADS
NUVERA 144 COPIER			1,000	1	20/1	2	1,000			VERSANT COLOR COPIER
NUVERA 144 COPIER			1,000	3	20/1	4	1,000			VERSANT COLOR COPIER
NUVERA 144 COPIER			1,000	5	20/1	6	1,000			VERSANT COLOR COPIER
NUVERA 144 COPIER			1,000	7	20/1	8				
NUVERA 144 COPIER			1,000	9	20/1	10	1,000			VERSANT COLOR COPIER
NUVERA 144 COPIER			1,000	11	50/3	12	1,000			VERSANT COLOR COPIER
-			2,500	13	-	20/1	14	1,000		VERSANT COLOR COPIER
-			2,500	15	-	20/1	16	1,000		VERSANT COLOR COPIER
CARMEN'S COMPUTER			1,000	17	20/1	18	360			NEOPOST ENVELOPE PRINTER
D95 COLOR COPIER			1,000	19	20/1	20	1,000			NEOPOST COMPUTER
D95 COLOR COPIER			1,560	21	20/2	22	1,000			FIERY COMPUTER
-			1,560	23	-	20/2	24	1,664		VERSANT COLOR COPIER
SHRINK WRAP			4,160	25	50/2	26	1,664			-
-			4,160	27	-	20/2	28	1,248		LAMINATOR
STERLING DIGI PERFECT BINDER			1,465	29	20/2	30		1,248		-
-			1,465	31	-	20/1	32	1,000		VERSANT COLOR COPIER
STERLING DIGI PERFECT BINDER			1,000	33	20/1	34	1,000			MORGANA FOLDER
SPIRAL BIND, COMB BIND			960	35	20/1	36		1,000		-
NUVERA 144 COPIER			1,000	37	20/1	38				SPARE
SPARE				39	20/1	40				SPARE
SPARE				41	20/1	42				SPARE
NOTES: * "L" DENOTES LONG CONTINUOUS LOAD										
TOTAL OA = 17,789 VOLT-AMPS			148.2 AMPS							
TOTAL OB = 17,468 VOLT-AMPS			145.6 AMPS							
TOTAL OC = 14,757 VOLT-AMPS			123 AMPS							
TOTAL PANEL = 50,014 VA @ 208V, 3Ø = 139 AMPS										

PANEL: BS		(NEW)								
LOCATION :		VOLTAGE/PHASE : 208Y/120V, 3Ø,4W		FED FROM : DISTRIBUTION BAORD 'DB'						
FLOOR : FIRST		BUS AMPS : 600A		RATING: 10KAIC						
MOUNTING : SURFACE		MAIN BREAKER : 600A/3P								
LOADS	SEE NOTE	* OUTLETS LTG REC MISC	VOLT-AMPS A B C	BKRV POLE	A B C	BKRV POLE	VOLT-AMPS A B C	OUTLETS LTG REC MISC	* SEE NOTE	LOADS
PANEL P1			24,913	1	225/3	2	19,309			PANEL P3
-			24,153	3	-	4	14,345			-
-			22,613	5	-	6	19,623			-
PANEL P2			17,789	7	225/3	8				INSTA WATER HEATER
-			17,468	9	-	10				-
-				11	-	12				-
SPARE				13	100/3	14				SPARE
-				15	-	16				-
-				17	-	18				-
SPARE				19	-	20				SPARE
SPARE				21	-	22				SPARE
SPARE				23	-	24				SPARE
SPARE				25	-	26				SPARE
SPARE				27	-	28				SPARE
SPARE				29	-	30				SPARE
SPARE				31	-	32				SPARE
SPARE				33	-	34				SPARE
SPARE				35	-	36				SPARE
SPARE				37	-	38				SPARE
SPARE				39	-	40				SPARE
SPARE				41	-	42				SPARE
NOTES: * "L" DENOTES LONG CONTINUOUS LOAD										
TOTAL OA = 62,011 VOLT-AMPS			516.8 AMPS							
TOTAL OB = 55,966 VOLT-AMPS			466.4 AMPS							
TOTAL OC = 59,993 VOLT-AMPS			499.9 AMPS							
TOTAL PANEL = 177,970 VA @ 208V, 3Ø = 494 AMPS										

PANEL: P3		(NEW)								
LOCATION :		VOLTAGE/PHASE : 208Y/120V, 3Ø,4W		FED FROM : PANEL 'BS'						
FLOOR : FIRST		BUS AMPS : 225A		RATING: 10KAIC						
MOUNTING : SURFACE		MAIN BREAKER : 225A/3P								
LOADS	SEE NOTE	* OUTLETS LTG REC MISC	VOLT-AMPS A B C	BKRV POLE	A B C	BKRV POLE	VOLT-AMPS A B C	OUTLETS LTG REC MISC	* SEE NOTE	LOADS
CRON PLATE MAKER			3,432	1	40/2	2	82			OFFICE 113 LT
-			3,432	3	-	4	12			EPSON 9800
CRON PLATE MAKER			3,432	5	40/2	6	180			CONVEYOR
CRON PLATE MAKER			3,432	7	-	8	960			PRINTING PRESS CONSOLE
-			1,000	9	20/1	10	1,440			SMALL STAPLER
CRON PLATE MAKER			1,000	11	20/1	12	1,440			SMALL STAPLER
RIP COMPUTER			1,800	13	20/1	14	1,000			PRINTING PRESS
MUTOH PRINTER			48	15	20/1	16	1,000			PRINTING PRESS
MUTOH COMPUTER			1,000	17	20/1	18	1,000			PRINTING PRESS
MUTOH CUTTER			360	19	20/1	20	192			CIRCULATION SYSTEM
MUTOH PRINTER			48	21	20/1	22	552			EPS FEEDER
OFFICE RECEIPT			1,620	23	20/1	24	1,404			PRINTING PRESS
OFFICE RESTROOM RECEIPT			900	25	20/1	26	1,404			-
EF-1, EF-2, EF-3			250	27	20/1	28	4,083			FORKLIFT CHARGER
CRON PLATE MAKER			1,664	29	20/2	30	4,083			-
-			1,664	31	-	32	4,083			-
QU-1			2,080	33	20/2	34	400			TRAP PRIMER TP-1, TP-2
-			2,080	35	-	36	720			RECEPTACLES
SPACE				37	-	38				SPACE
SPACE				39	-	40				SPACE
SPACE				41	-	42				SPACE
NOTES: * "L" DENOTES LONG CONTINUOUS LOAD										
TOTAL OA = 19,309 VOLT-AMPS		160.9 AMPS								
TOTAL OB = 14,345 VOLT-AMPS		119.5 AMPS								
TOTAL OC = 19,623 VOLT-AMPS		163.5 AMPS								
TOTAL PANEL = 53,277 VA @ 208V, 3Ø = 148 AMPS										



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SHEET TITLE

SCHEDULES

DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

E-003

DATE: NOVEMBER 2, 2018 SHEET ____ OF

PLOT BY: MOHAMMAD WAJAF PLOT DATE: Nov 09, 2018 - 2:25PM DRAWING NAME: R:\0463\ELECTRICAL\0463_E201_FFIRST FLOOR LIGHTING

LIGHT FIXTURE SCHEDULE

TYPE	FIXTURE DESCRIPTION	MANUFACTURER & MODEL	TOTAL V-A	LAMP TYPE	LUMENS	COLOR TEMP	CRI	VOLTAGE	MTG	CEILING TYPE	REMARKS
A1	RECESSED 2 X 4 LED FIXTURE	PHILIPS-EVOKIT-2X4-42L-32W-835	32	LED	4200	3500K	-	120-277V	R	-	NOTE 1
A2	RECESSED 2 X 4 LED FIXTURE	PHILIPS-EVOGRID-2-EV-G-43L-835-4-DS-UNV-DIM	41	LED	4200	3500K	-	120-277V	R	-	-
A3	RECESSED 2 X 4 LED FIXTURE WITH TUNABLE COLOR TEMPERATURE	PHILIPS-EVOGRID-2-EV-G-43L-8TW-4-D-UNV-DTW	41	LED	4200	2700-6000K	-	120-277V	R	-	-
B1	CANOPY FIXTURE	PHILIPS-SFC-3-48L-700-NW-G-2-UNV-MGY-PCB	60	LED	4200	4000K	-	120-277V	C	-	-
C1	WALL PACK	PHILIPS-WP-30-NW-G1-8-BZ	29	LED	3355	3500K	-	120-277V	W	-	-

NOTES:

1. RETROFIT EXISTING TROFFER WITH LED FIXTURE. PROVIDE ALL ACCESSORIES WITH KIT FOR A COMPLETE INSTALLATION

MOUNTING ABBREVIATIONS:

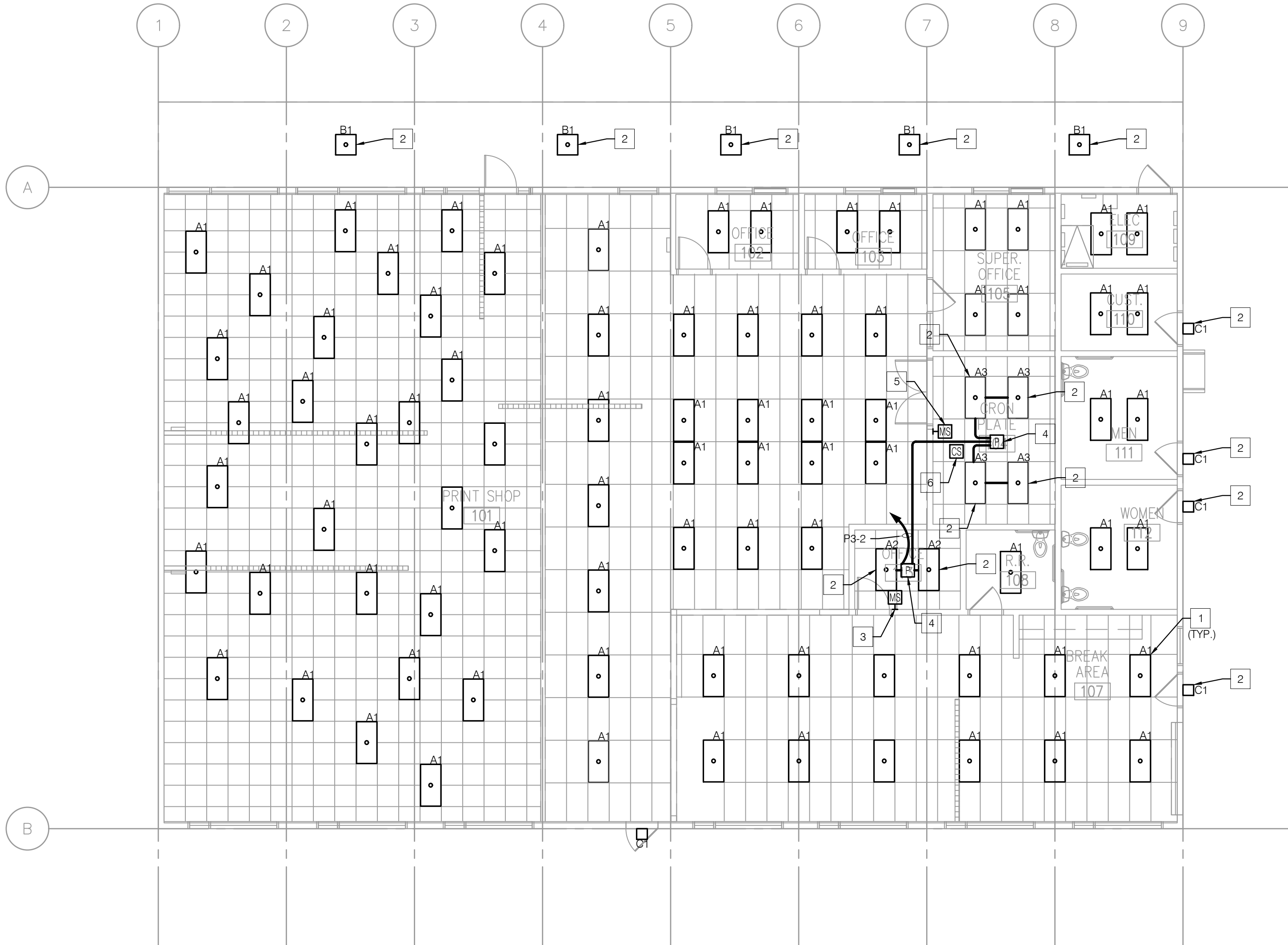
R = RECESSED
S = SURFACE
W=WALLPACK
C=CEILING

GENERAL NOTES

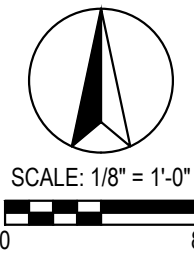
1. REFER TO LUMINAIRE SCHEDULE ON THIS SHEET FOR ADDITIONAL INFORMATION.

NOTES

- 1 PROVIDE RETROFIT KIT ALONG WITH ALL ACCESSORIES FOR A COMPLETE INSTALLATION.
2 PROVIDE FIXTURE AS SHOWN. REFER TO LUMINAIRE SCHEDULE ON THIS SHEET FOR ADDITIONAL INFORMATION.
3 PROVIDE WALL SWITCH OCCUPANCY SENSOR AS SHOWN. (CAT: NWSXPDTLV-WH).
4 PROVIDE RELAY PACK AS SHOWN (CAT: NPP16D).
5 PROVIDE WALL SWITCH AS SHOWN (CAT: FRESCO-FCS-7TSN-X).
6 PROVIDE CEILING MOUNTED OCCUPANCY SENSOR AS SHOWN. (CAT:NCM PDT 9)



1 LIGHTING PLAN
1/8" = 1'-0"



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SHEET TITLE

FIRST FLOOR
LIGHTING PLAN

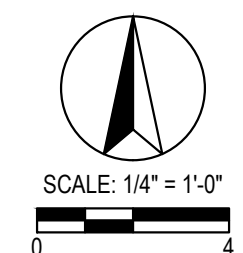
DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

E-201

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

1	PROVIDE PANEL AS SHOWN. REFER TO SINGLE LINE DIAGRAM ON SHEET E501 FOR EQUIPMENT TYPE AND RATING.	8	PROVIDE 50A, 240V, 3P, 14-50R FLOOR MOUNTED RECEPTACLE AS SHOWN.
2	PROVIDE 60A, 3P, 600V FUSED DISCONNECT SWITCH IN NEMA 1 ENCLCLOSURE WITH 60E FUSE AS SHOWN.	9	PROVIDE 20A, 240V, 2P, 6-20R RECEPTACLE AS SHOWN.
3	PROVIDE 30A, 3P, 600V NON-FUSED DISCONNECT SWITCH IN NEMA 1 ENCLCLOSURE AS SHOWN.	10	PROVIDE 20A, 120V FLOOR MOUNTED DUPLEX RECEPTACLE AS SHOWN.
4	PROVIDE 30A, 2P, 600V NON-FUSED DISCONNECT SWITCH IN NEMA 1 ENCLCLOSURE AS SHOWN.	11	PROVIDE FLOOR MOUNTED JUNCTION BOX AS SHOWN.
5	PROVIDE 20A, 120V DUPLEX GFCI RECEPTACLE TO SERVE REFRIGERATOR AS SHOWN.	12	PROVIDE WALL MOUNTED DATA OUTLETS AS SHOWN.
6	PROVIDE 20A, 120V DUPLEX GFCI RECEPTACLE TO SERVE MICROWAVE AS SHOWN.	13	PROVIDE 60A/2P NON FUSED DISCONNECT SWITCH IN NEMA 1 ENCLOSURE AS SHOWN.
7	PROVIDE 20A, 120V DUPLEX RECEPTACLE AS SHOWN.	14	PROVIDE FLOOR MOUNTED DATA OUTLETS AS SHOWN.



PMSM
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SHEET TITLE

FIRST FLOOR
POWER PLAN

DRAWN BY: MH/QP JOB NUMBER: 18116.03

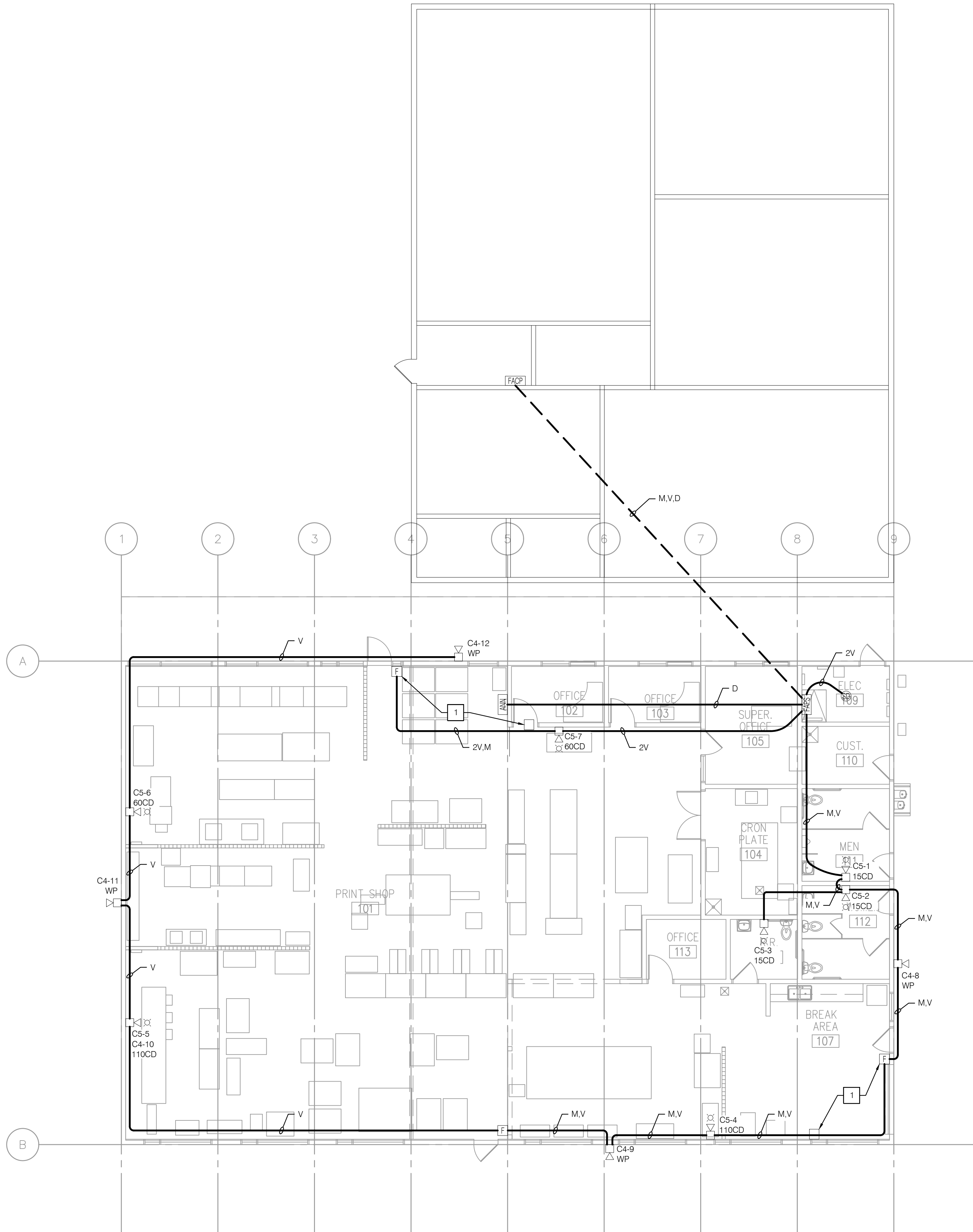
SHEET NO. _____

E-211

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

PLOT BY: MOHAMMAD WASIF
PLOT DATE: Nov 09, 2018 - 2:25PM
DRAWING NAME: C:\USERS\MOHAMMAD WASIF\AppData\Local\Temp\ACPublish_114921\94.83.E21\FIRST FLOOR.PLR.DWG

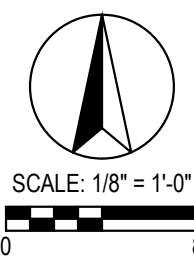
PLOT BY: MOHAMMAD WAFI
PLOT DATE: Nov 09, 2018 - 2:25PM
DRAWING NAME: C:\USERS\MOHAMMAD WAFI\APPDATA\LOCAL TEMPORARY\1102\10483.E221.FIRST FLOOR PLWNG



1 FIRE ALARM PLAN
1/8" = 1'-0"

NOTES

- 1 RELOCATE EXISTING MANUAL PULL STATION AS SHOWN.



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YUCAIPA, CA 92399

SHEET TITLE

**FIRST FLOOR FIRE
ALARM PLAN**

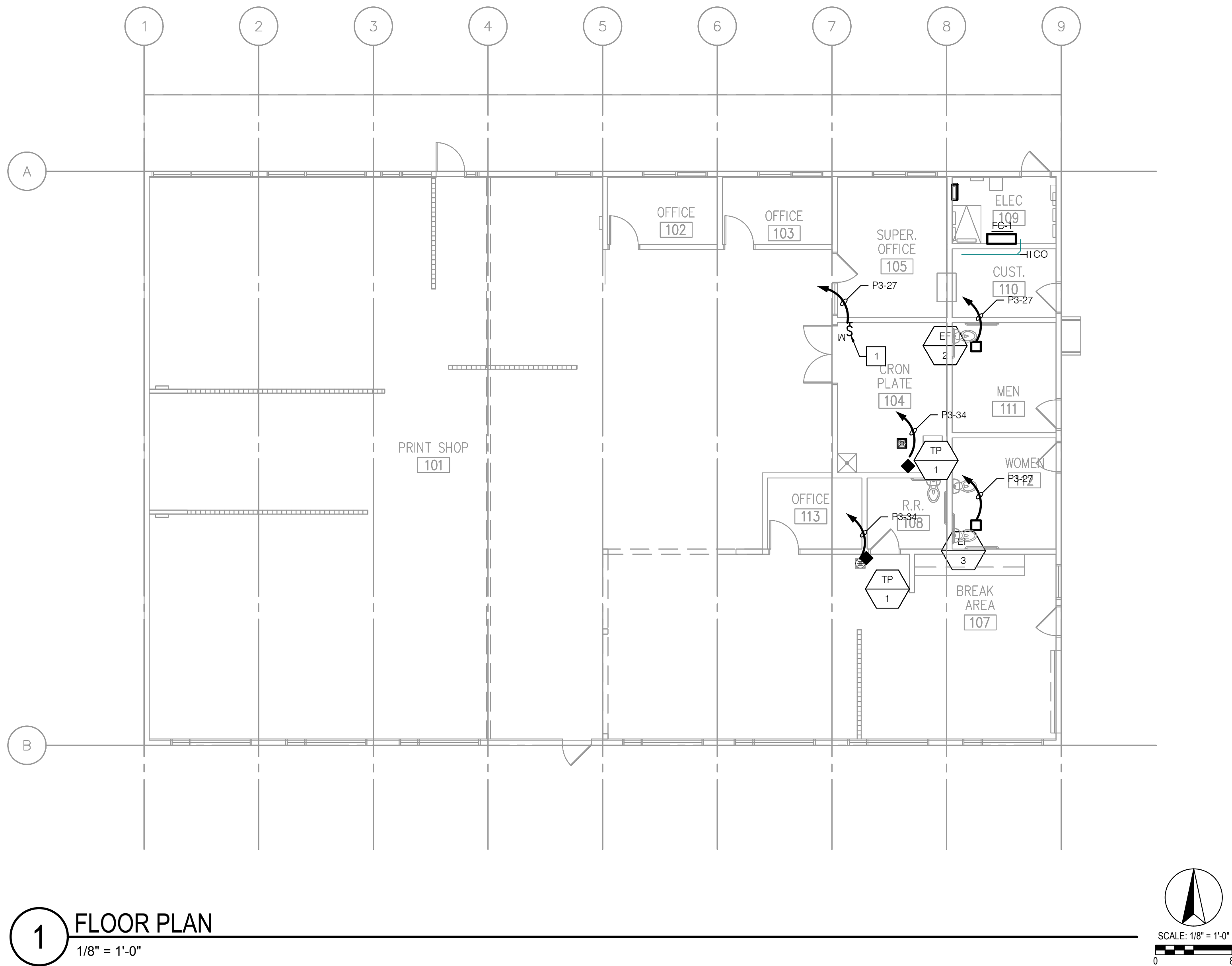
DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

E-221

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

PLOT BY: KHAMKHAO WAPF
PLOT DATE: Nov 09, 2018 - 2:25PM
DRAWING NAME: P:\0463\ELECTRICAL\0463.E231-FIRST FLOOR AUX PLAN.DWG



GENERAL NOTES

1. REFER TO MECHANICAL EQUIPMENT SCHEDULE ON SHEET M002 FOR ADDITIONAL INFORMATION.

NOTES

1. PROVIDE 20A, 120V MOTOR RATED SWITCH TO SERVE EXHAUST FAN FOR CRON PLATE ROOM AS SHOWN. REFER TO SHEET E232 FOR LOCATION OF EXHAUST FAN.



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SHEET TITLE

FIRST FLOOR
AUXILIARY
POWER PLAN

DRAWN BY: MH/QP

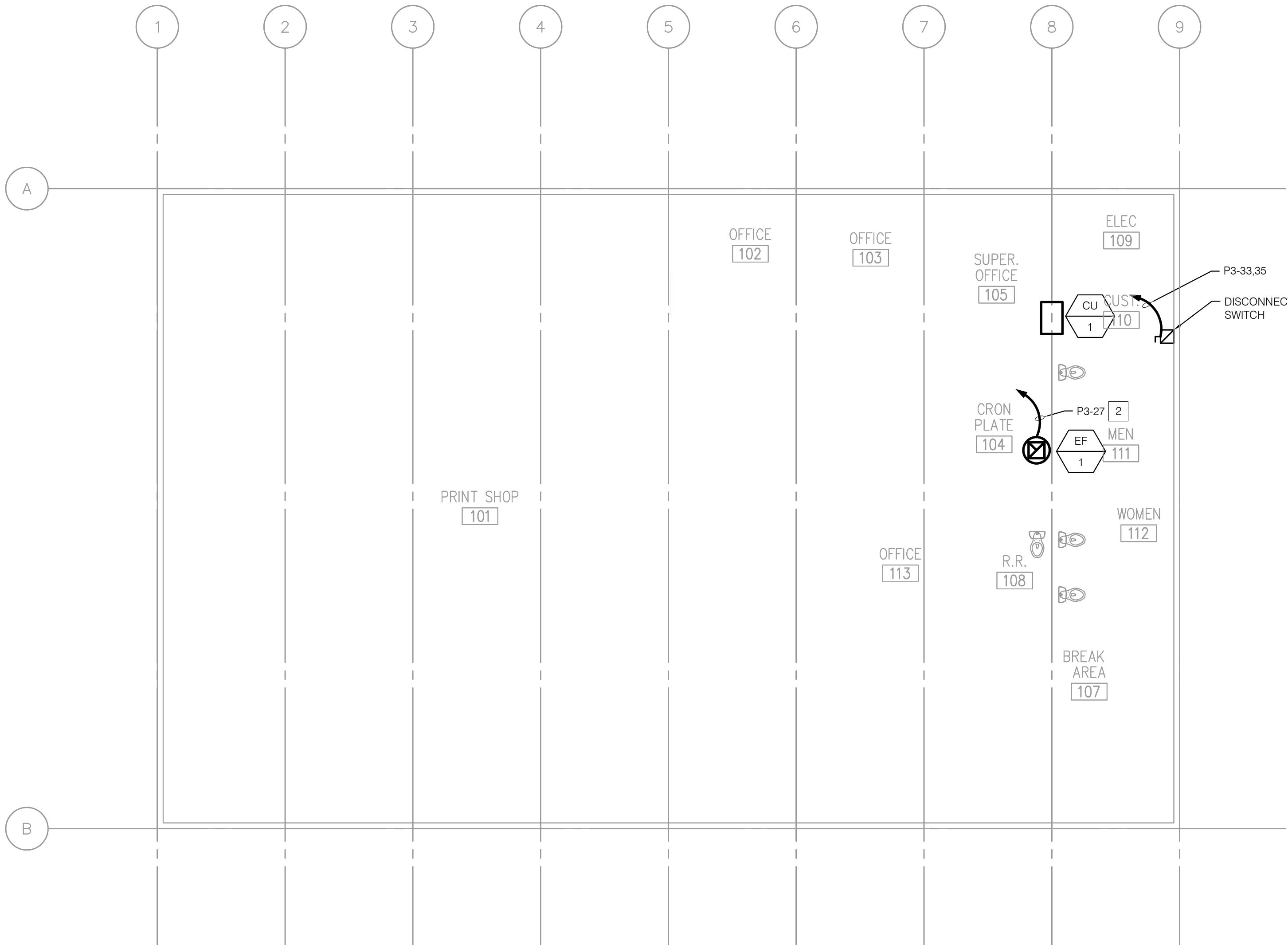
JOB NUMBER: 18116.03

SHEET NO.

E-231

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

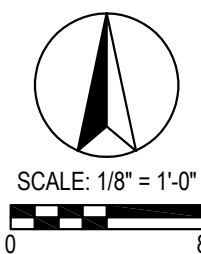
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 PLOT DATE: NOV 09, 2018 - 2:26PM
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1 AUXILIARY POWER PLAN
 1/8" = 1'-0"

NOTES

- 1 PROVIDE 30A, 3P, 600V NON-FUSED DISCONNECT SWITCH IN NEMA 3R ENCLCLOSURE AS SHOWN.
 2 WIRE FAN VIA 20A, 120V MOTOR RATED SWITCH LOCATED IN THE CRON PLATE ROOM.



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 PRINT SHOP T.I. AT
 CRAFTON HILLS
 COLLEGE BL 14
 11711 SAND CANYON ROAD
 YUCAIPA, CA 92399

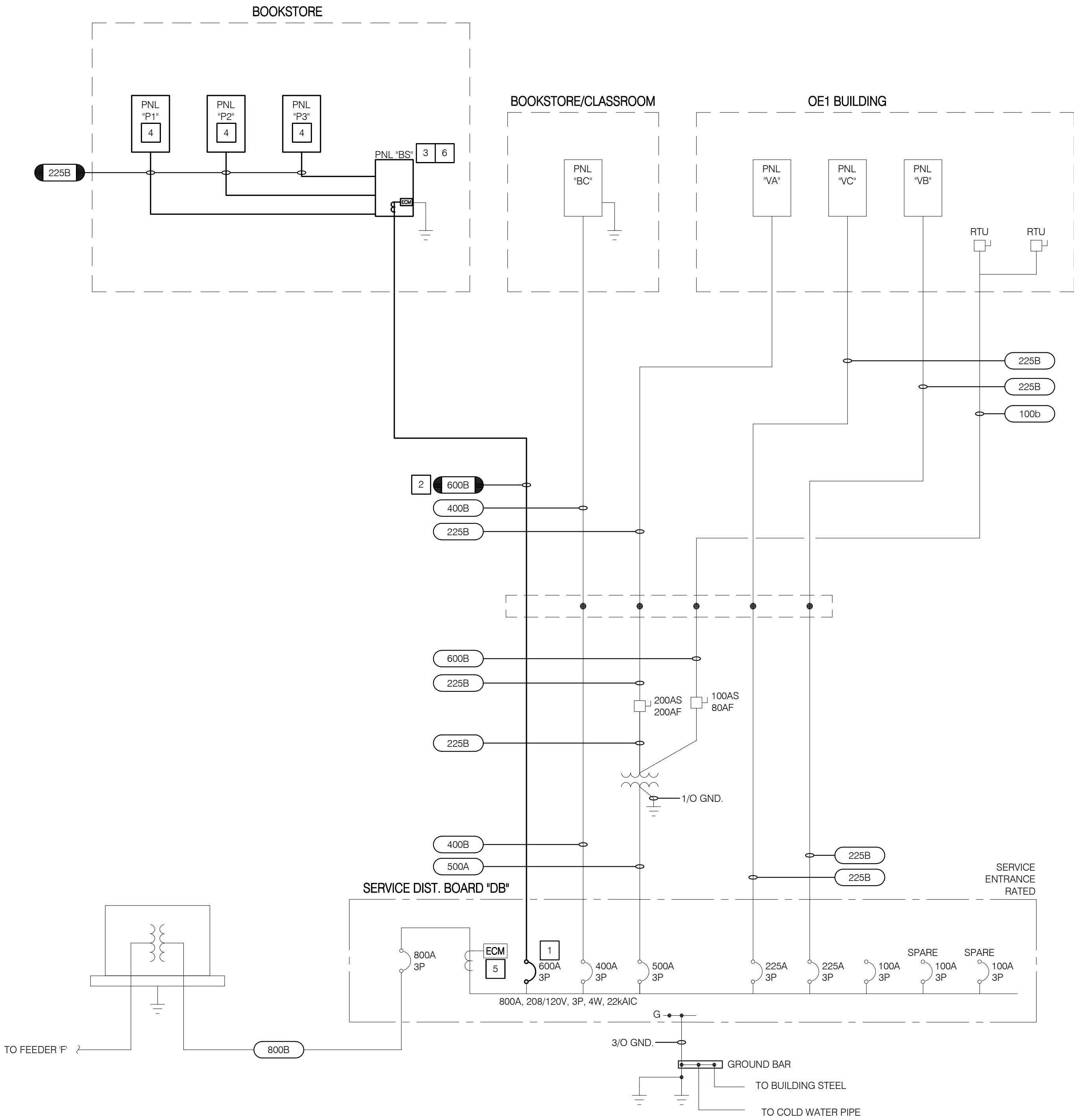
SHEET TITLE
 ROOF AUXILIARY
 POWER PLAN

DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

E-232

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____



NOTES

- 1
- PROVIDE 600A, 3P, 600V CIRCUIT BREAKER AT EXISTING DISTRIBUTION BOARD 'DB' AS SHOWN. BREAKER TYPE, RATING AND MANUFACTURER SHALL MATCH EXISTING BREAKER RATINGS.
- 2
- PROVIDE FEEDER IN EXISTING CONDUIT AS SHOWN.
- 3
- PROVIDE 600A, 208Y/120V, 3Ø, 4W DISTRIBUTION PANEL AS SHOWN.
- 4
- PROVIDE 225A, 208Y/120V, 3Ø, 4W PANEL AS SHOWN.
- 5
- INTEGRATE EXISTING METER WITH CAMPUS ENERGY DASHBOARD SYSTEM.
- 6
- PROVIDE DIGITAL METER WITH CTS AND ALL ASSOCIATED ACCESSORIES AS SHOWN.

FEEDER SCHEDULE		
SYMBOLS	CONDUIT	SETS OF CONDUCTORS PER CONDUIT
	5"	3 #250 kCMIL (15kV, 133% EPRI) & 1 #4/O GND.
	1-1/2"	4 #4 & 1 #8 GND.
	1-1/2"	3 #2 & 1 #8 GND.
	1-1/2"	4 #2 & 1 #8 GND.
	2"	3 #1 & 1 #6 GND.
	2"	4 #1/0 & 1 #6 GND.
	2-1/2"	4 #3/0 & 1 #6 GND.
	3"	4 #350 kCMIL & 1 #1 GND.
	2-1/2"	4 #4/O CU, & 1 #4 GND.
	4"	4 #600 kCMIL & 1 #2 GND.
	(2)3"	3#250KCM & 1 #2GND. EACH
	4"	8#400KCM & 1 #2/OGND.
	(2) 4'	4 #600 kCMIL & 1 #1/0 GND. EACH
	(2) 4'	4 #600 kCMIL & 1 #1/0 GND. EACH

LOAD CALCULATIONS *		
	AMPS	KVA
BOOKSTORE	486A	= 174.9 kVA @ 208V
BOOKSTORE CLASSROOM	110A	= 39.6 kVA @ 208V
PANEL 'VA'	15.9A	= 13.3 kVA @ 480V
PANEL 'VB'	25A	= 9 kVA @ 208V
PANEL 'VC'	35A	= 12.6 kVA @ 208V
TOTAL		= 671.9A, 242.5kVA @ 208V, 3PH, 4W

LOAD SUMMARY DISTRIBUTION PANEL 'BS'		
	AMPS	KVA
PANEL 'P1'	199	= 71.679
PANEL 'P2'	139	= 50.014
PANEL 'P3'	148	= 53.27
TOTAL	486	= 174.98



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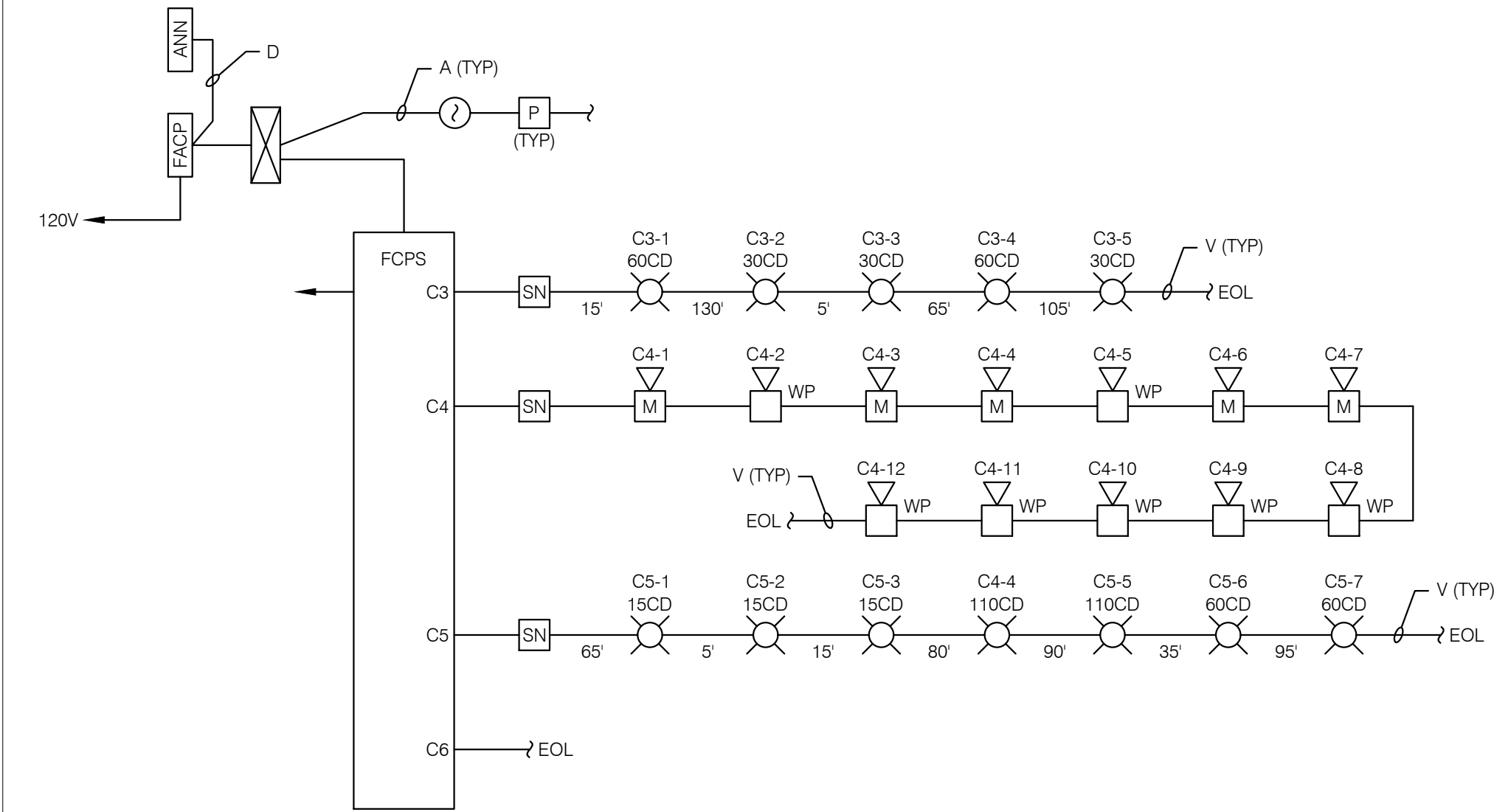
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SINGLE LINE
DIAGRAM

DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

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DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

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PLOT DATE: Nov 09, 2018 - 2:25PM



FIRE ALARM RISER DIAGRAM

VOLTAGE LOSS CALCULATIONS				
DEVICES	(A)AMPS	VOLTAGE DROP FORMULA		
NAC TRIP	0.015	%VD = $\frac{\text{AMPERE} \times \text{DISTANCE} \times 21.6}{\text{CIRCULAR MILS}} \times \frac{100}{\text{VOLT}}$		
EXT. HORN	0.038			
15CD STROBE	0.046			
30CD STROBE	0.057			
60CD STROBE	0.082	WHERE:		
110CD STROBE	0.102	WIRE GAUGE		12
MINI HORN	0.012	WIRE RESISTANCE		21.6
HORN	0.021	CIRCULAR MILLS		6530
ZINCHRONIZATION MODULE	0.020	VOLTS (DC)		24

LOOP 1	NAC TRIP	EXT HORN	15CD STROBE	30CD STROBE	60CD STROBE	110CD STROBE	HORN	MINI HORN	SYNCHRONIZER	TOTAL AMPS	WIRE FOOTAGE	LINE LOSS
FACP BSU/C												
CIRCUIT 1 (HORNS) FACP TRIP	4	0	0	0	0	0	0	0	0	0.00	0.00	
LOOP 2												
CIRCUIT 1	5											
FCPS PANEL												
CIRCUIT 3 (STROBES)	0	0	0	3	2	0	0	0	1	0.355	320'	1.56%
CIRCUIT 4 (HORNS)	0	6	0	0	0	0	1	5	1			
CIRCUIT 3 (STROBES)	0	0	3	0	2	2	0	0	1	0.526	385'	2.70%
CIRCUIT 3 (SPARE)	0	0	0	0	0	0	0	0	0	0	0	
TOTAL	0	6	3	3	4	2	1	5	3			

FIRE ALARM RISER CALCULATIONS

BATTERY CAPACITY CALCULATION SHEET						
FACP						
LOCATION: MEDIA ROOM						
QUANTITY (INCLUDES FUTURE DEVICES)	MODEL #	DESCRIPTION	STANDBY UNIT CURRENT (AMPS)	STANDBY TOTAL CURRENT (AMPS)	ALARM UNIT CURRENT (AMPS)	ALARM TOTAL CURRENT (AMPS)
1	FACP BSU/C	ANALOG CONTROL PANEL WHICH INCLUDES ALU, PSU AND SCU	0.072	0.072	0.287	0.287
1	KDU	KEYBOARD DISPLAY UNIT	0.050	0.050	0.057	0.057
12	AMM-2	ADDRESSABLE MONITOR MODULE	0.001	0.016	0.013	0.156
12	AMM-4	ADDRESSABLE MONITOR MODULE	0.001	0.009	0.013	0.010
2	ASD-P	SMOKE DETECTORS (PHOTOELECTRIC)	0.000	0.027	0.005	0.000
0	ATDR	HEAT DETECTORS	0.000	0.000	0.013	0.000
0	ASD-P	DUCT DETECTORS	0.000	0.000	0.005	0.000
TOTAL				0.147		0.666

BATTERY CALCULATIONS

ASSUMPTIONS:		
A) REQ'D BATTERY BACKUP - STANDBY	24 HRS	
B) REQ'D BATTERY BACKUP - ALARM	10 MIN	(0.16667 HOURS)
C) ALLOWABLE ERROR	25%	
D) TOTAL STANDBY BACKUP (AMP/HOURS)	3.528	
E) TOTAL ALARM BACKUP	0.111	
F) ALLOWABLE ERROR (C X (D+E))	0.910	
TOTAL AMP/HR REQ'D (D+E+F)		4.55 AMP/HRS
BATTERIES SUBMITTED:		NP12-12 AMP HOUR: 12 AH

BATTERY CAPACITY CALCULATION SHEET						
FCPS						
LOCATION: MEDIA ROOM						
QUANTITY	MODEL #	DESCRIPTION	STANDBY UNIT CURRENT (AMPS)	STANDBY TOTAL CURRENT (AMPS)	ALARM UNIT CURRENT (AMPS)	ALARM TOTAL CURRENT (AMPS)
1	FCPS	SUPPLEMENTARY NOTIFICATION APP CIRCUIT	0.060	0.060	0.120	0.120
6		EXTERIOR HORN	0.000	0.000	0.038	0.228
3		15CD STROBE	0.000	0.000	0.046	0.138
3		30CD STROBE	0.000	0.000	0.057	0.171
4		60CD STROBE	0.000	0.000	0.082	0.328
2		110CD STROBE	0.000	0.000	0.102	0.204
1		HORN	0.000	0.000	0.021	0.021
5		MINI HORN	0.000	0.000	0.012	0.060
3		SYNCHRONIZATION MODULE	0.000	0.000	0.020	0.060
TOTAL				0.060		1.330

BATTERY CALCULATIONS

ASSUMPTIONS:		
A) REQ'D BATTERY BACKUP - STANDBY	24 HRS	
B) REQ'D BATTERY BACKUP - ALARM	10 MIN	(0.16667 HOURS)
C) ALLOWABLE ERROR	25%	
D) TOTAL STANDBY BACKUP (AMP/HOURS)	1.440	
E) TOTAL ALARM BACKUP	0.222	
F) ALLOWABLE ERROR (C X (D+E))	0.415	
TOTAL AMP/HR REQ'D (D+E+F)		2.077 AMP/HRS
BATTERIES SUBMITTED:		NP7-12 AMP HOUR: 7 AH



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SHEET TITLE

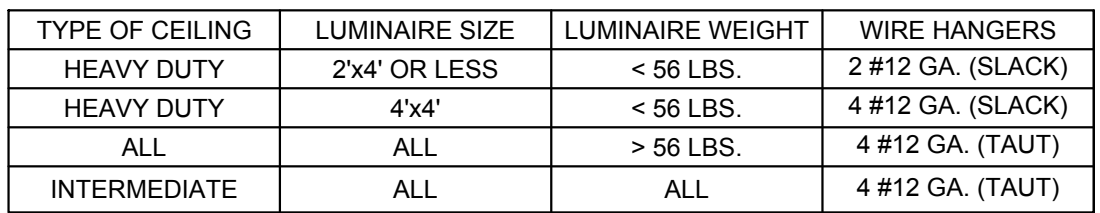
FIRE ALARM
CALCULATIONS

DRAWN BY: MH/QP JOB NUMBER: 18116.03

SHEET NO.

E-502

DATE: NOVEMBER 2, 2018 SHEET ____ OF ____

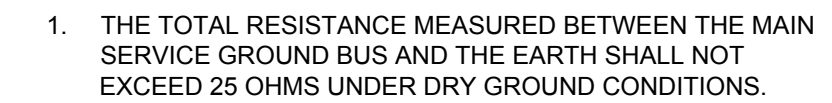


1	24"x48" LAMP RECESSED LIGHTING FIXTURE.
2	12 GA. GALVANIZED STEEL WIRE. SEE TABLE BELOW FOR NUMBER OF SUPPORT WIRES REQUIRED PER FIXTURE. SECURE TO EXISTING STRUCTURAL MEMBERS SIMILAR TO EXISTING SUPPORT WIRES. SEE NOTE 1 BELOW.
3	CEILING SUPPORT WIRES. SEE NOTE 2 BELOW.
4	PROVIDE 3 TIGHT TURNS WITHIN 1-1/2".
5	INSTALL 2#8 SHEET METAL SCREWS AT EACH END OF FIXTURE NEAR CORNER FROM INSIDE OF FIXTURE.
6	FOR ANCHOR DETAIL, SEE ARCHITECTURAL.
7	MAINTAIN (1) HOUR FIRE RATED CEILING. PROVIDE ACOUSTICAL MATERIAL, 5/8" MINIMUM THICKNESS, FORM A 5 SIDED (TRAPEZOIDAL IN CROSS-SECTION) ENCLOSURE AROUND LUMINAIRE. PROVIDE 3" MINIMUM SPACE FROM TOP OF LUMINAIRE AND THE ENCLOSURE. ENCLOSURE SHALL BE HELD TOGETHER BY 3D NAIL AT 12" ON CENTER MINIMUM.
8	EXISTING T-BAR GRID.
9	EXISTING FIRE RATED ACOUSTIC TILE FINISHED CEILING.

1. INSTALL LUMINAIRE SUPPORTS IN ACCORDANCE WITH THE REQUIREMENTS OF INTERPRETATION OF REGULATIONS IR-47-3, TITLE 24, PARTS 1 AND 2, CALIFORNIA CODE OF REGULATIONS.
2. SUPPORT RECESSED LUMINAIRES IN ACCORDANCE WITH THE FOLLOWING TABLE:



- 4 RECESSED MOUNTED LIGHT FIXTURE - FIRE RATED T-BAR CEILING
NO SCALE



- ### 3 SWITCHBOARD GROUNDING

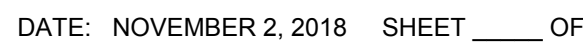


EXHIBIT F

Print Shop Relocation to CHC Specs

SAN BERNARDINO COMMUNITY
COLLEGE DISTRICT

CRAFTON HILLS COLLEGE

PRINT SHOP TENANT IMPROVEMENTS
AT BL 14

PROJECT MANUAL

CONSTRUCTION DOCUMENTS
BID SET

NOVEMBER 2, 2018



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PROJECT MANUAL FOR CRAFTON HILLS COLLEGE PRINT SHOP TENANT IMPROVEMENTS AT BL 14

SAN BERNARDINO COMMUNITY COLLEGE DISTRICT
YUCAIPA, CALIFORNIA

SPECIFICATIONS

BIDDING DOCUMENTS NOTE: BIDDING DOCUMENTS ARE NOT DSA-APPROVED AND THEREFORE SUBJECT TO CHANGE. USE OF UNAPPROVED DOCUMENTS FOR CONSTRUCTION ARE AT OWNER'S SOLE RISK. ARCHITECT AND CONSULTANTS ARE NOT LIABLE FOR USE OF UNAPPROVED DOCUMENTS.

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SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Work covered by the Contract Documents.
 - 2. Type of the Contract.
 - 3. Work phases.
 - 4. Use of premises.
 - 5. Owner's occupancy requirements.
 - 6. Work restrictions.
 - 7. Specification formats and conventions.
 - 8. Deferred Approvals.
 - 9. Pollution Control.
- B. Related Sections include the following:
 - 1. Division 1 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
 - 2. Division 1 Section "Closeout Procedures" for mechanical and electrical Title 24 Certificate of Acceptance requirements.

1.3 SUBMITTALS

- A. Contractor shall submit written statement of responsibility per CBC 1704A

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. Project Identification: Parkview Elementary School-Administration Building Entry Renovation
 - 1. Project Location:
 - Crafton Hills College
 - 11711 Sand Canyon Rd.
 - Yucaipa, CA 92399
- B. Owner:
 - 1. San Bernardino Community College District
 - 114 South Del Rosa Dr.
 - San Bernardino, CA 92408

- C. Architect: 19six/PMSM Architects.
- D. The Work consists of the following: ALTERATIONS TO EXISTING MODULAR BUILDING TO HOUSE THE DISTRICT PRINT SHOP.

1.5 TYPE OF CONTRACT

- A. Project site work and utilities connections for the entry renovation project will be constructed under a design-bid-build project delivery method. The general contractor shall construct all work related to the scope of this project.

1.6 WORK PHASES

- A. The Work shall be conducted in single phase.

1.7 USE OF PREMISES

- A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits.
- B. Use of Site: Limit use of premises to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Owner Occupancy: Allow for Owner occupancy of Project site and use by the public.
 - 2. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.8 OWNER'S OCCUPANCY REQUIREMENTS

- A. Full Owner Occupancy: Owner will occupy site and adjacent building during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits, unless otherwise indicated.
 - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
 - 2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- B. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied before Owner occupancy.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
3. Before partial Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of building.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

1.9 WORK RESTRICTIONS

- A. On-Site Work Hours:
 1. Comply with General Conditions.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 1. Notify Architect not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Architect's written permission.

1.10 SPECIFICATION FORMATS AND CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using the 48-division format and CSI's "MasterFormat 2004" numbering system.
 1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
 2. Division 1: Sections in Division 1 govern the execution of the Work of all Sections in the Specifications.
- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

- a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

1.11 POLLUTION CONTROL

- A. Provide positive methods, means and facilities required to prevent contamination of the soil, water or atmosphere by the discharge of noxious substances from the construction operations.

1.12 MISCELLANEOUS PROVISIONS

- A. General: Comply with the Project Conditions of Approval for both noise and dust control. If there is any conflict between drawings and specifications and the Project Conditions of Approval regarding noise and dust control, the Project Conditions of Approval shall govern.
- B. Noise Control: The Contractor shall install noise reducing devices on construction equipment. Contractor shall comply with the requirements of the city and county having jurisdiction with regard to noise ordinances governing construction sites and activities. Construction Equipment noise at the Site shall be limited and only as permitted by applicable law, rule or regulation. If classes are in session at any point during the progress of the Work, and, in the Owner's reasonable discretion, the noise from any Work disrupts or disturbs the students or faculty, at the Owner's request, the Contractor shall schedule the performance of all such Work around normal school hours or make other arrangements so that the Work does not cause such disruption or disturbance. In no event shall such arrangements result in adjustment of the Contract Price or the Contract Time.
- C. Dust Control. The Contractor shall be fully and solely responsible for maintaining and upkeeping all areas of the Site and adjoining areas, outdoors and indoors, free from flying debris, grinding powder, sawdust, dirt and dust as well as any other product, product waste or work waste, that by becoming airborne may cause respiratory inconveniences to persons, particularly to students and Owner's personnel. Additionally, the Contractor shall take specific care to avoid deposits of airborne dust or airborne elements. Such protection devices, systems or methods shall be in accordance with the regulations set forth by the EPA and OSHA, and other applicable law, rule or regulation. Additionally, the Contractor shall be the sole party responsible to regularly and routinely clean up and remove any and all deposits of dust and other elements. Damage and/or any liability derived from the Contractor's failure to comply with these requirements shall be exclusively at the cost of the Contractor, including, without limitation, any and all penalties that may be incurred for violations of applicable law, rule or regulation, and any amounts expended by the Owner to pay such damages shall be due and payable to the Owner on demand. Contractor shall replace any damages property or part thereof and professionally clean any and all items that become covered or partially covered to any degree by dust or other airborne elements. If classes are in session at any point during the progress of Work, and, in the Owner's reasonable discretion, flying debris, grinding powder, sawdust, dirt or dust from any Work disrupts or disturbs the students or faculty or the normal operation of the college, at the Owner's request, the Contractor shall schedule the performance of all such Work around normal college hours and make other arrangements so that the Work does not cause such disruption or disturbance. In no event shall such arrangements result in adjustment of the Contract Price or the Contract Time.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 02 41 00

DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Building demolition excluding removal of hazardous materials and toxic substances.
- B. Abandonment and removal of existing utilities and utility structures.

1.2 RELATED DOCUMENTS

- A. Section 01 52 40 – Construction Waste Management: Limitations on disposal of removed materials; requirements for recycling.
- B. Section 31 23 23 – Backfilling: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

1.3 REFERENCE STANDARDS

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

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.
 - 1. Minimum of 5 years of documented experience.

PART 2 - NOT USED

PART 3 - EXECUTION

3.1 SCOPE

- A. Remove the entire building designated on drawings.
- B. Remove paving and curbs as required to accomplish new work.
- C. Within area of new construction, remove foundation walls and footings to a minimum of 3 feet below finished grade.
- D. Outside area of new construction, remove foundation walls and footings to a minimum of 3 feet below finished grade.
- E. Remove concrete slabs on grade within construction limits indicated on drawings.
- F. Remove manholes and manhole covers curb inlets and catch basins.
- G. Remove fences and gates.
- H. Remove other items indicated, for salvage, relocation, and recycling.
- I. Fill Excavations, open pits, and holes in ground areas generated as a result of removals, using specified fill; compact fill as specified in Division 31.
- J. Fill Excavations, open pits, and holes in ground areas generated as a result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

3.2 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with other requirements specified in Division 01.
- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Comply with applicable requirements of NFPA 241.
 - 3. Use of explosives is not permitted.

4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 5. Provide, erect, and maintain temporary barriers and security devices.
 6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 8. Do not close or obstruct roadways or sidewalks without permit.
 9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- C. Do not begin removal until receipt of notification to proceed from College District.
- D. Do not begin removal until built elements to be salvaged or relocated have been removed.
- E. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.
- F. Protect existing structures and other elements that are not to be removed.
1. Provide bracing and shoring.
 2. Prevent movement or settlement of adjacent structures.
 3. Stop work immediately if adjacent structures appear to be in danger.
- G. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- H. If hazardous materials are discovered during removal operations, stop work and notify Architect and College District; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- I. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.
- J. Perform demolition in a manner that maximizes salvage and recycling of materials.
1. Comply with requirements of Section 01 52 40 - Construction Waste Management.
 2. Dismantle existing construction and separate materials.
 3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.
- K. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.3 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to College District.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to College District.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.4 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 52 40 - Construction Waste Management.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 03 10 00 - CONCRETE FORMWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Provide concrete formwork for all cast-in-place concrete.

1.3 RELATED SECTIONS

- A. Section 03 20 00 - Reinforcing Steel.
- B. Section 03 30 00 - Cast-in-Place Concrete.

1.4 REFERENCES

- A. The latest editions of specifications and standards referenced herein and published by the following organizations applies to the Work of this Section only to the extent specified by the reference.

ACI	American Concrete Institute
PS	U.S. Department of Commerce Product Standards
WCLIB	West Coast Lumber Inspection Bureau
WWPA	Western Wood Products Association

1.5 DESIGN REQUIREMENTS

- A. Design, engineer and construct formwork, shoring and bracing to conform to requirements of 2016 CBC and the following Publications.

ACI 347 - Standard Recommended Practice for Concrete Formwork.
ACI 301 - Specifications for Structural Concrete for Buildings.
ACI 318 - Building Code Requirements for Reinforced Concrete

- B. Complete concrete elements to conform to required shape, line and dimensions. Include all possible loading conditions in the design of formwork and shoring. Ensure all applicable safety laws are strictly enforced and maintain a safe construction Project.

1.6 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specifications Sections.

1.7 QUALITY ASSURANCE

- A. Codes and Standards: Perform Work in compliance with applicable requirements of governing authorities having jurisdiction.

Chapter 19A of the 2016 California Building Code including all Applicable State of California Amendments (CBC).

1. Article 1.05 Design Requirements of this Section 03 1000.

- B. Construction and maintenance of all concrete formwork shall be under the continuous supervision of a foreman with not less than 3 years of successful experience in the forming and the removal of forms for architectural quality work.

1.8 DELIVERY, STORAGE AND PROTECTION

- A. Deliver and store all forms and materials above ground in a manner to protect them from damage, contamination and deterioration.

1.9 COORDINATION

- A. Coordinate the Work of other Sections and Divisions shown to be incorporated into concrete elements. Work of others shown passing through footings and concrete walls are only allowed if detailed on the Structural Drawings.

PART 2 – PRODUCTS

2.1 FORM MATERIAL

- A. Forms for Unexposed Concrete: Form concrete surfaces which will not be exposed in the finished structure with plywood, lumber, metal or other acceptable material.
 - 1. Lumber: Standard or better grade Douglas Fir, meeting the requirements of WCLIB “Standard Grading Rules No. 16” or WWPA “Western Lumber Grading Rules 88. Use boards which are surfaced on at least 2 edges and one side for a tight fit.
 - 2. Plywood: B-B Plyform, Class I, exterior grade meeting the requirements of PS 1, 5/8-inch minimum thickness for 12 inch stud spacing and 3/4-inch minimum thickness for 16

inch stud spacing.

- B. Forms for Exposed Finish Concrete: Construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practical sizes to minimize number of joints. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
- C. Framing, Studding and Bracing: "Standard" or "Construction" grade Douglas Fir, S4S, meeting the requirements of the WCLIB "Standard Grading Rules No. 16" or WWP "Western Lumber Grading Rules 88."
- D. Form Coating: Non-grain raising and non-staining type that will not leave residual matter on surface of concrete or adversely affect proper bonding of subsequent application of other material applied to concrete surface. Coatings containing mineral oils or other nondrying ingredients will not be permitted. Form coating for use with form liners shall be of type recommended by form liner manufacturer.
- E. Nails: Common wire, steel.
- F. Waterstop: 3/16" thick, ribbed, PVC waterstop by Greenstreak or approved equal.

2.2 TIES AND SPREADERS

- A. Form Ties and Spreaders: Standard metal form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete surfaces. Inner tie rod shall be left in concrete when forms are removed. Wire ties or wood spreaders will not be permitted. Form ties shall be a type which does not leave an open hole through the concrete and which permits neat and solid patching at every hole.

PART 3 – EXECUTION

3.1 ERECTION

- A. Concrete below grade may be placed directly against earth in open trenches. Side forms for footings may be of earth provided the soil will stand without caving and the side of the banks are made with neat cuts to minimum dimensions indicated on the Drawings.
- B. Where footing excavations exceed widths and lengths shown on the Drawings, extend formwork to bottom of excavation.
- C. Make all necessary provisions to prevent cave-ins during the placement of concrete.
- D. All forms shall be constructed true to line and level, sufficiently tight to prevent leakage of mortar, and shall conform per ACI Standards, to the dimensions of the finished concrete as

shown on the Drawings. Finished concrete surfaces shall show no visible signs of bow or deflection.

- E. Wooden supports or spreaders for forms shall not extend into concrete pours.
- F. Set and secure all required steel assemblies, angles, pipe sleeves, bolts, inserts, and other such items required to be anchored in the concrete before the concrete is placed.
- G. Construct all forms straight, true, plumb, and square within a tolerance horizontally of one in 200 and a tolerance vertically of one in 500.
- H. Keep forms sufficiently wetted to prevent joints opening up before concrete is placed.
- I. Bracing:
 - 1. Properly brace and tie the forms together so as to maintain position and shape and to ensure safety of personnel.
 - 2. Construct all bracing, supporting members and centering of ample size and strength to safely carry, without excessive deflections, all dead and live loads to which they may be subjected.
 - 3. Properly space the forms apart and securely tie them together using metal spreader ties that give positive tying and accurate spreading.

3.2 REMOVAL OF FORMS

- A. Do not disturb or remove forms until the concrete has developed sufficient strength to safely sustain its own weight and superimposed loads above. After concrete is placed, a minimum time period of ten days shall elapse before the removal of forms can be considered.
 - 1. Forms for at grade concrete may be removed in 24 hours providing removal does not damage surfaces and edges of concrete.
- B. Use all means necessary to protect workers, passers by, the installed Work of other trades, and the complete safety of the structure.
- C. Cut nail and tie wires or form ties off flush, and level all surfaces smooth and clean.
- D. Remove metal spreader ties on exposed concrete by removing or snapping off inside the wall surfaces and patching up the resulting pockets to match the surrounding areas.
- E. Flush all holes resulting from the use of spreaders, rods and sleeve nuts, using water, and then solidly pack throughout the wall thickness with cement grout applied under pressure by means of a grouting gun; grout shall be one part Portland cement to 2.5 parts sand; apply grout immediately after removing forms.

Section continued on next page

3.3 SUBMITTAL REQUIREMENTS AND SCHEDULE

- A. Include this form with submittals of this Specification Section, unless a substitution product is being proposed, in which case refer to Division 1 Section "Substitutions" for Substitution requests.

Contractor's	Contractor is to acknowledge with initials each submittal included.
Initials	Attach a letter of explanation for each submittal not included

_____ All submitted products are as specified.

- B. SUBMITTAL SCHEDULE:

_____ 1. Qualifications (relevant experience) of foreman.

END OF SECTION 03 10 00

SECTION 03 20 00 - REINFORCING STEEL

PART 1 – GENERAL

1.1 RELATED DOCUMENT

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Furnish, fabricate and install all reinforcing steel for cast-in-place concrete as necessary to complete all reinforced concrete work.
- B. Furnish and fabricate reinforcing steel only for masonry construction.

1.3 RELATED SECTIONS

- A. Section 03 10 00 - Concrete Formwork
- B. Section 03 30 00 - Cast-in-Place Concrete

1.4 REFERENCES

- A. The latest editions of specifications and standards referenced herein and published by the following organizations apply to the Work only to the extent specified by the reference.

ASTM	American Society for Testing and Materials
ACI	American Concrete Institute
AWS	American Welding Society
CRSI	Concrete Reinforcing Steel Institute
CBC STDS	2016 California Building Code Standards

1.5 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specifications Sections.
- B. Refer to “Submittal Requirements and Schedules” Article at the end of this Section for required submittals.

1.6 QUALITY ASSURANCE

- A. Codes and Standards: Perform Work in accordance with applicable requirements of governing authorities having jurisdiction.
 - 1. Chapters 19A and 21A of the 2016 California Building Code.
- B. Provide mill Reports for all types and sizes of reinforcing steel for review and acceptance prior to fabrication and transporting reinforcing steel to the construction site.
 - 1. Mill reports shall contain the steel source, description, heat number, yield point, ultimate tensile strength, elongation percentage, bend test and chemical analysis.
 - a. If the reports show that material is satisfactory no tests will be required.
 - b. For foreign steel, testing as specified below will be required by a testing laboratory acceptable to the Architect and DSA.
 - c. Certification from any other sources will not be acceptable.
 - 2. Ensure that the material delivered for use is that represented by the mill reports and obtain copies of mill reports, examine them, certify whether the material represented complies with Specifications requirements, and make distribution of reports as required. Report chemical composition of each heat, as determined by ladle analysis.
 - 3. Where materials proposed for use cannot be identified, the Owner shall pay for an approved testing laboratory to make one series of tests (tensile and bend) from each 2.5 tons, or fraction thereof, of each size and kind of reinforcing steel. Include 2 samples, minimum, of sufficient length to allow tests to be made on the as-rolled bar. The Owner shall then back-charge the Contractor for all testing fees.
- C. Contact Architect for observation of all concrete reinforcing.
- D. Testing and Inspections shall comply with Section 01 41 00 and as noted in the Contract Documents.

1.7 DELIVERY, STORAGE AND PROTECTION

- A. Bundle reinforcing steel and tag with suitable identification to facilitate sorting and placing in accordance to the placement drawings.
- B. Store above ground, in a manner to prevent excessive rusting and fouling with dirt, grease, and other bond breaking coatings.

1.8 COORDINATION

- A. Coordinate the Work of other Sections and Divisions shown to be incorporated into concrete elements. Work of others shown passing through footings and concrete walls are only allowed if detailed on the Structural Drawings.

- B. Coordinate placement locations of all masonry dowels with Section 04 2000 whenever they are required to be embedded in cast-in-concrete.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. All materials shall be new, free from rust and mill scale. Reinforcing bars shall comply with ASTM A 615:

Grade 60 for all bars.
- B. Reinforcing bars shown welded on the Drawings and welded in the field shall be new material, free from rust and mill scale, conforming to ASTM A 706, Grade 60 for all sizes.
- C. Tie Wire: 16 gage, annealed conforming to ASTM A 82.
- D. Welding Electrodes: AWS A5.1 or Grade E70XX for welding Grade 60, ASTM A 706 bars.

2.2 SUPPORTS FOR REINFORCING BARS

- A. Provide supports for reinforcement including bolsters, chairs, spacers, concrete block and other devices for spacing, supporting and fastening reinforcing bars in place.

PART 3 – EXECUTION

3.1 FABRICATION

- A. General
 - 1. Bend all bars cold. Comply with ACI 318-14 Section 26.6.3.
 - 2. Do not use bars with kinks or bend not shown on the Drawings.
 - 3. Make bends for stirrups and ties in accordance with details on the Drawings.
- B. Fabricate and place reinforcing steel in accordance with CRSI Manual of Practice, ACI” SP-66 and ACI 318-14.
- C. Welding of ASTM A 706 reinforcing shall conform to ACI 318-14 Section 26.6.4.

3.2 PLACING

- B.A. General: Before commencing with concrete placement, accurately place all concrete reinforcing steel including dowels for masonry. Secure in place and provide positive support

using concrete block, metal chairs or spacers, or by metal hangers. Set tie-wire ends directed into concrete, away from formed exposed concrete surfaces. Comply with ACI 318-14 Section 26.6.2.

1. Reinforcing steel shall be placed in accordance with the Drawings and the latest edition of the CRSI "Manual of Standard Practice".

B. Clearance:

1. Preserve clear space between bars of not less than one times the nominal diameter of reinforcing, but not less than 1.33 times the maximum size of coarse aggregate, nor less than 1 inch.
2. Provide minimum concrete coverage for reinforcing as noted in the General Notes shown on Drawings. Minimum concrete coverage dimensions also applies to tie wires.

C. Splicing:

1. Horizontal and vertical bars:
 - a. Place bars with minimum lap at splices to develop the strength of the bar.
 - b. Bars may be wired together at laps.
 - c. Whenever possible, stagger the splices of adjacent bars.
 - d. Splice bars a minimum as shown on the Drawings.
 - e. Clear spacing to be the same as Section 3.2B(1) above.

3.3 CLEANING REINFORCEMENT

- A. Steel reinforcement, at the time concrete is placed, shall be free from rust, loose mill scale, oil, paint, and all other coatings which will destroy or reduce bond between steel and concrete, and between steel and grout. Comply with ACI 318-14, Section 26.6.1.2.

Section continued on next page

3.4 SUBMITTAL REQUIREMENTS AND SCHEDULE

- A. Include this form with submittals of this Specification Section, unless a substitution product is being proposed, in which case refer to Division 1 Section "Substitutions" for Substitution requests.

Contractor's Contractor is to acknowledge with initials each submittal included. Attach a
letter of explanation for each submittal not included.

Initials

_____ All submitted products are as specified.

B. SUBMITTAL SCHEDULE:

- _____ 1. Mill certificates for each size and grade of steel intended for use in the
Project, stating physical and chemical properties and compliance with
ASTM requirements.
- _____ 2. Placement sheets and related details. Indicate sizes, fabricated shapes,
dimensions, spacing, material, grade and locations within concrete and
masonry Work.
- _____ 3. Epoxy adhesive.

END OF SECTION 03 20 00

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Provide finish, cure, repair, protect and clean (where exposed) all cast-in-place concrete required for foundations, starter walls, slabs-on-grade, and other concrete indicated.
- B. Provide moisture barriers, granular subbase and sand cover for moisture barrier located below concrete slabs cast-on-grade.

1.3 RELATED SECTIONS

- A. Section 03 10 00 - Concrete Formwork
- B. Section 03 20 00 - Reinforcing Steel

1.4 REFERENCES

- A. The latest editions of specifications and standards referenced herein and published by the following organizations apply to the Work of this Section only to the extent specified by the reference.

ACI	American Concrete Institute
ASTM	American Society for Testing and Materials
CBC STDS	2016 California Building Code Standards

1.5 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specifications Sections.

- B. Refer to “Submittal Requirements and Schedules” Article at the end of this Section for required submittals.

1.6 QUALITY ASSURANCE

- A. Codes and Standards: Perform Work in compliance with applicable requirements of governing authorities having jurisdiction.
 - 1. Chapter 19A of the 2016 California Building Code including all applicable State of California Amendments (CBC).
 - 2. ACI 301 - Specifications for Structural Concrete for Buildings.
 - 3. ACI 318 - Building Code Requirements for Reinforced Concrete.
 - 4. ACI Publication SP-15 - Specifications for Structural Concrete for Buildings with selected ACI and ASTM references. All apply to the Work of this Section where applicable.
- B. Specified aggregates, cement, and color from single sources only.
- C. Approved concrete mix designs shall not be altered without approval of the Architect.
- D. Testing and Inspection: Shall comply with Special Inspection form D-103, Special Inspections stated in structural drawings, and with the 2016 CBC except as modified below.
 - 1. Contractor shall coordinate and provide access to all locations for specimen sampling and inspection.
 - 2. Contractor shall notify Project Inspector at least 48 hours prior to commencing preparation for placement of concrete. Coordinate and provide access to all locations for testing and inspection of Concrete Work.
- E. Contractor and tradesmen constructing forms, placing and curing Architectural concrete for walls, columns and piers shall have at least five years of successful experience in this work. Provide experience records and references to Architect immediately upon receiving notice to proceed.
- F. Concrete must have a Floor Flatness, Ff, of at least 50 with a minimum of 35. Concrete must have a Floor Levelness, Fl, of at least 40.

1.7 DELIVERY, STORAGE AND PROTECTION

- A. Deliver and store all materials in a manner to protect them from damage, contamination and deterioration.

1.8 COORDINATION

- A. Coordinate with Divisions 12, 14, 22, 26 and other Divisions requiring items of their Work to be embedded into cast-in-place concrete.

- B. Notify Architect and Project Inspector a minimum of 24 hours prior to each commencement of concrete placement and before forms are closed-in.

PART 2 – PRODUCTS

2.1 CONCRETE MATERIALS

- A. Cement: ASTM C 150, Type II
- B. Course and Fine Aggregates: ASTM C 33
- C. Water: Clean and not be detrimental to concrete

2.2 ADMIXTURES

- A. Chemical: Water Reducing per ASTM C 494, Type A
- B. Fly Ash: ASTM C 618, Type F

2.3 ACCESSORIES

- A. Bonding Agent: Polymer resin emulsion
- B. Vapor Barrier: Class A conforming to ASTM Standard E 1745-11.
- C. Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing a minimum compressive strength of 5,000 psi within 28 days.
- D. Concrete Adhesive: “SET-XP” Adhesive by Simpson Strong-Tie Company, Hilti (Hilti “HIT-RE 500-V3”), or approved equal.
- E. Curing compound:
 - 1. Liquid membrane-forming compound complying with ASTM C 309, Type 1 (1D), Class B, guaranteed not to affect the appearance of the concrete surfaces, and the bond, adhesion, or effectiveness of finishes and surface treatment specified herein to be applied to concrete.
 - 2. Curing compound used on exposed concrete surfaces shall be non-discoloring, fast drying and shall be conclusively demonstrated not to darken or yellow with age.
 - 3. Curing compound for use on concrete floors to receive adhered covering shall be specially formulated for such use and shall be certified by the manufacturer not to inhibit

the bonding qualities of flooring adhesives.

2.4 JOINT DEVICES AND FILLER MATERIALS

- A. Closed cell polyvinyl chloride form, resilient, recovery of 95 percent if not compressed more than 50 percent of original thickness.
- B. Construction Joint Devices: Non-metallic tongue and groove profile.
- C. Sealants and primers: As specified in Section 07 90 00.

2.5 CONCRETE MIX

- A. Submit concrete mix design(s) prepared by a testing laboratory, designed by a registered civil or structural engineer, and approved by Architect review and acceptance, prior to delivery of concrete to site.
 - 1. Provide cast-in-concrete to meet the following:
 - a. Normal (Stone) weight concrete in accordance with ACI 301, except as noted below
 - b. Minimum 28-day compressive strength:
 - 1. Concrete over metal deck & footings: 3,000 psi
 - c. Maximum water-cement ratio:
 - 1. Concrete over metal deck & footings: 0.45
 - d. Slump: 4" (plus or minus 1 inch) unless noted otherwise.
 - e. Fly Ash - (up to a maximum of 18% of cement content by volume).
 - f. Coarse aggregate to be Santa Margarita Granite Aggregate, San Gabriel Aggregate, Heavy-Media Processed; or other clean coarse aggregate of lower or equal reactivity.
 - g. Fine aggregate from Santa Margarita Granite Aggregate, Moorpark Source, or other clean fine aggregate of lower or equal reactivity.
 - h. Calcium chloride not allowed.
- B. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C 94 and furnish batch ticket information.

2.6 SUBBASE BELOW CONCRETE SIDEWALKS AND SLABS-ON-GRADE:

- A. Clean, free draining Santa Margarita Granite sand, Moorpark Source, or those pre-approved non-reactive fine aggregate.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify requirements for minimum concrete cover over reinforcement.
- B. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.2 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
- B. In locations where new concrete is doweled to existing Work, drill holes in existing concrete, insert steel dowels and fill solid with concrete adhesive.
- C. Coordinate the placement of joist devices with erection of concrete formwork and placement of form accessories.

3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 318-14 Section 26.5.2, and ACI Publication SP 15.
- B. Place concrete continuously between predetermined expansion, control, and construction joints.
- C. Do not interrupt successive placement; do not permit cold joints to occur.
- D. Place slabs in checkerboard pattern as indicated.
- E. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints are not disturbed during concrete placement.
- F. Maintain legible copies of all transit mixed trip tickets signed by a certified weight master and records of concrete placement. Record date, location, quantity, air temperature, and test samples taken for each load delivered to site.

3.4 CONCRETE FINISHING

- A. Provide smooth rubbed finish for exposed interior concrete walls.
- B. Finish concrete floor surfaces in accordance with ACI 301.

1. Steel trowel surfaces for all interior slabs unless noted otherwise.

3.5 CURING AND PROTECTION

- A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Cure floor surfaces with two (2) coats of spray applied curing compound in accordance with ACI 308.
- D. Curing of concrete shall comply with ACI 318-14 Section 26.5.3.

3.6 PATCHING

- A. Notify Architect and Project Inspector to review concrete surfaces immediately upon removal of forms.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Architect upon discovery.
- C. Patch imperfections as directed.

3.7 DEFECTIVE CONCRETE

- A. Defective Concrete Definition: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by the Architect.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon approval of Architect for each individual area.

3.8 TESTS & INSPECTIONS

- A. Tests and inspections shall comply with Section 01 4100 of these specifications.

Section continued on next page

3.8 SUBMITTAL REQUIREMENTS AND SCHEDULE

- A. Include this form with submittals of this Specification Section, unless a substitution product is being proposed, in which case refer to Division 1 Section "Substitutions" for Substitution requests.

Contractor's Contractor is to acknowledge with initials each submittal included. Attach a letter of explanation for each submittal not included.

Initials

_____ All submitted products are as specified.

- B. SUBMITTAL SCHEDULE:

- _____ 1. Product Data:
- a. Concrete Aggregates
 - b. Cement
 - c. Admixtures
 - d. Integral Colors
 - e. Curing materials
 - f. Attachment devices

- _____ 2. Concrete mix designs.

END OF SECTION 03 30 00

SECTION 05 12 00 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Provide labor, equipment, supervision and structural steel as shown on the Drawings, specified herein and as needed for a complete and proper installation.

1.3 RELATED SECTIONS

- A. Section 032000 - Reinforcing Steel
- B. Section 033000 - Cast-in-Place Concrete
- C. Section 053100 - Metal Deck
- D. Section 099100 – Painting

1.4 REFERENCES

- A. The latest editions of specifications and standards referenced herein, published by the following organizations, apply to the Work of this Section only to the extent specified by the reference.

AISC American Institute of Steel Construction.
ASTM American Society for Testing and Materials.
AWS American Welding Society.
SSPC Steel Structures Painting Council.

1.5 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specifications Sections.
- B. Refer to “Submittal Requirements and Schedules” Article at the end of this Section for required submittals.

1.6 QUALITY ASSURANCE

- A. Fabricate structural steel members and assemblies in accordance with AISC Code of Standard Practice and Specifications. Company performing the Work of this Section shall have a least five years of satisfactory experience in fabricating structural steel.
- B. Qualification of Welders: Qualify welding procedures and welding operators in accordance with AWS D1.1, including the installation of welded studs & metal deck. Provide certifications that welders to be employed have satisfactorily passed AWS qualification tests within the past 12 months. If recertification of welders is required, retesting will be the Contractor's responsibility.
- C. Codes and Standards: Perform Work in compliance with applicable requirements of governing authorities having jurisdiction.
 - 1. Chapter 22A of the 2016 California Building Code including all applicable State of California Amendments (CBC).
 - 2. AISC 360-10 Specification for Structural Steel Buildings.
 - 3. AISC 341-10 Seismic Provisions for Structural Steel Buildings.
- D. Erector: Company specializing in the Work for this Section shall have at least 5 years of satisfactory experience in the erection of structural steel.
- E. Testing and Inspections: Comply with Chapter 22A of the 2013 CBC, Section 014100 Testing and Inspection and as noted on the Structural Drawings.
 - 1. Contractor shall notify Owner's Testing and Inspection Service at least 48 hours prior to shop welding and prior to field welding of structural steel. Coordinate and provide access to all locations for testing and inspection of structural steel Work.

1.7 DELIVERY, STORAGE AND PROTECTION

- A. Delivery and Storage:
 - 1. Deliver members and materials to the job site properly marked to identify the location for which they are intended and in time to insure uninterrupted progress of the construction.
 - 2. Use markings corresponding to markings shown on the approved Shop Drawings.
 - 3. Store materials in a manner to preclude damage and permit ready access for inspection and identification of each shipment. Store steel materials, either plain or fabricated, above the ground upon platforms, pallets, skids, or other supports.
 - 4. Keep materials free from dirt, grease, and other foreign matter, and protect from corrosion. Material showing evidence of damage will be rejected and shall be immediately removed from the site.

1.8 COORDINATION

- A. Coordinate locations of items to be embedded in and/or attached to the Work of Sections 03 10 00, 03 30 00 and 05 31 00.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Use only new and undamaged materials. Steel which in the opinion of the Architect is corroded or physically damaged shall not be incorporated in the construction.
- B. Exposed Steel Work: Where steel surfaces are exposed to view in the finish construction, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness. Remove such blemishes by grinding or by welding and grinding; before cleaning, treating and application of surface finishes.

2.2 MATERIALS

- A. Structural steel wide flange shapes: ASTM A 992, Grade 50.
- B. Angles, channels, plates, rods and bars: ASTM A36
- C. Structural steel tubes: ASTM A 500, Grade B.
- D. Structural steel pipe: ASTM A 53, Type E or S, Grade B.
- E. Common Bolts and Nuts: ASTM A 325N. Provide hexagonal heads and nuts where exposed and where embedded in masonry.
- F. Anchor bolts and Rods: ASTM F 1554
- G. Automatic End Welded Studs: Studs shall be Nelson Granular Fluxfilled Shear Connectors or Anchor Studs, or an approved equal. Studs shall be manufactured of C-1015 cold rolled steel conforming to ASTM Specification A-108. When welding through deck, the stud diameter shall not be greater than 2.5 times the beam flange thickness. Comply with AWS D1.1.
- H. Filler metal for welding: Meet the requirements of AWS D1.1. Electrodes shall be as recommended by their manufacturer for position and other conditions of actual use. Electrodes shall be E70 series.
- I. Primer: Manufacturer's or fabricator's standard, fast curing, lead free, universal modified alkyd primer selected for good resistance to normal atmospheric corrosion, for compatibility with finish paint systems indicated and for capability to provide a sound foundation for field applied topcoats despite prolonged exposure, complying with performance requirements of

Federal Specifications TT-P-645.

- J. Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additive, capable of developing a minimum compressive strength of 5,000 psi in 7 days.
- K. Galvanize structural steel assemblies, members and connectors not permanently protected from weather and moisture per ASTM A 123.
- L. Templates: Any commercial grade steel, not less than 10 gage.
- M. Galvanizing Repair Compound: High zinc dust content galvanizing repair paint conforming to Mil. Spec DOD-P-21035A, hot applied zinc rich material or equal.
- N. Reinforcing steel shall conform to Section 03 20 00.

2.3 FABRICATION

- A. Fabricate and assemble materials in the shop to the greatest extent possible. Shearing, flame cutting, and chipping shall be done carefully and accurately. Coordinate connection details where steel is connected to concrete and masonry. Verify lines, levels, and dimensions, where possible, just before commencing fabrication of connection details. Correct construction that does not fit. Schedule and coordinate construction under this Section with that specified elsewhere. When not otherwise indicated or specified, comply with application requirements of AISC "Specifications for Design, Fabrication and Erection of Structural Steel for Buildings".
- B. Before beginning fabrication or Work, wire-brush materials clean of loose mill scale and rust, and straighten by methods that will not injure the steel and so that they will comply with AISC tolerances.
- C. Welded Connections: Make welded connections in accordance with AWS D1.1. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp. Grind and dress smooth all welds exposed to view in the finish construction, so that the shape and profile of the item welded is preserved.
- D. Automatic End-Welded Studs: The studs shall be automatically end welded in accordance with AWS D1.1 in such a manner as to provide complete fusion between the end of the stud and the plate. There shall be no porosity or evidence of lack of fusion between the welded end of the stud and the plate. The stud shall decrease in length during welding approximately 1/8" for 5/8" diameter studs and under, and 3/16" for stud diameters greater than 5/8" diameter. Welding shall be done only by qualified welders approved by the welding inspector.
- E. Holes: Cut, drill, or punch holes at right angles to the surface of the metal. Do not cut or enlarge holes by burning. Holes may be enlarged by careful reaming. Holes in base or bearing plates shall be drilled. Holes shall be provided in members to permit connection the

construction of other trades.

1. Material may be punched 1/16 inch larger than the nominal diameter of the bolt, whenever the thickness of metal is equal to or less than the diameter of the bolt plus 1/8 inch.

- F. Templates: Fabricate individual templates for each and every assembly to be anchored to or embedded in concrete and/or masonry. Locate working centerlines of each template by drilling hole or deep center punch. Remove templates prior to erection of members.

2.4 SHOP PAINTING

- A. General: Shop paint structural steel except galvanized members or those members or portions of members to be embedded in concrete or in masonry & grout. On embedded steel which is partially exposed, paint the exposed portion and the initial 2 inches of embedded areas only. Do not paint surfaces to be welded.
- B. Surface Preparation: After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale and splatter, slag or flux deposits using power tool cleaning in accordance with SSPC SP-3.
- C. Painting: Immediately after surface preparation, apply shop primer in accordance with manufacturer's instructions and at a rate to provide a dry film thickness of not less than 1.5 mils. Use painting methods which results in full coverage of joints, corners, edges and exposed surfaces, without drips, sags, etc.

2.5 GALVANIZING

- A. General: All steel and ferrous metal items located on the exterior of the buildings, exposed to moisture and otherwise indicated to be galvanized shall be galvanized by the hot-dip process, meeting the requirements of ASTM A 123. All required hot-dip galvanizing shall be done after fabrication, in the largest sections possible. Items too large for available dip tanks shall be sprayed, by approved methods, with molten zinc to coating thickness of 0.003 inch to 0.004 inch.
- B. Coating Weight: Weight of the Zinc coating per square foot of actual surface shall average not less than 2.0 ounces and no individual specimen shall be less than 1.8 ounces.
- C. Repair of Coating: Restore shop galvanized metal necessitating field soldering or welding which in any manner removes original galvanizing, by using galvanizing repair compound in accordance with manufacturer's instructions.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Field measure and Templates: Secure field measurements required for proper and adequate fabrication and installation. Furnish templates for exact location of items to be embedded in concrete and/or masonry including instructions required for installation.
- B. Temporary Shoring and Bracing: In accordance with California Code of Regulations (CCR), Title 8, design, provide temporary shoring, erection bracing and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are securely in place and final connections are complete. Provide temporary guy lines to achieve proper alignment of structure as erection proceeds.

3.2 ERECTION

- A. Setting Base and Bearing Plates: After the supported members have been plumbed, aligned and properly positioned, set base and bearing plates. Support plates on adjustable bolt supports or shims until grout has set. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Follow grout manufacturer's instructions.
- B. Framing: Except as specified herein, erect framing in accordance with AISC Code of Standard Practice and the 2013 CBC. Plan and layout framing so that cutting will not be required. Erect construction plumb, square, and true to line, level, and position indicated within tolerances established in the AISC Code of Standard Practice.
- C. Holding and Protection: In assembling and during welding hold the component parts with sufficient clamps or other adequate means to keep parts straight and in close contact. In welding, take precautions to minimize "lock-up" stress and distortion due to heat. In wind, perform welding only after adequate wind protection is furnished and set up.
- D. Connections: Bolt field connections except where welding is indicated. Perform welding as specified for shop welding.
- E. On exposed construction, remove erection bolts, temporary welds, run-off plates and backing strips. Fill erection bolt holes with plug welds and grind smooth.
- F. Testing shall comply with Section 01 41 00.

Section continued on the next page

3.3 SUBMITTAL REQUIREMENTS AND SCHEDULE

- A. Include this form with submittals of this Specification Section, unless a substitution product is being proposed, in which case refer to Division 1 Section "Substitutions" for Substitution requests.

Contractor's _____ Contractor is to acknowledge with initials each submittal included. Attach a letter of explanation for each submittal not included.

Initials

_____ All submitted products are as specified.

B. SUBMITTAL SCHEDULE:

- _____ 1. Fabricator's Qualifications
- _____ 2. Erector's Qualifications
- _____ 3. Mill test certificates including heat or melt numbers for each type and size of steel used in the Work.
- _____ 4. Shop and erection drawings including complete details and schedules for fabrication, shop and field assembly of members and erection bracing. Should more than one submittal be required, late submittals shall clearly identify materials added or revised subsequent to previous submittal.
 - a. Shop drawings and fabricated assemblies and members shall be properly marked to identify their location on site.
 - b. Indicate each weld by AWS symbol, size, type and length of weld.
 - c. Provide setting drawings, templates and directions for installing anchor bolts and other steel assemblies into concrete and/or masonry.
 - d. Identify shop drawing details by reference to sheet and detail number of the Drawings.
- _____ 5. Welder's Certificates: Certify welders employed on the Work, verify AWS qualification within the previous 12 months.

END OF SECTION 05 12 00

SECTION 053100 - METAL DECK

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Floor metal deck where metal deck is indicated on the plans.

1.2 RELATED SECTIONS

- A. Section 051200: Structural Steel
- B. Section 033000: Cast-In-Place Concrete

1.3 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who have a minimum of five years experience in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work.
- B. When the materials are used as part of an assembly indicated on the plans in which fire-resistive construction ratings are required, submit specifications demonstrating approval by Underwriters' Laboratories, Inc., and DSA.
- C. Welders shall be AWS Certified for welding of light gauge metal materials.

1.4 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specifications Sections.
- B. Refer to "Submittal Requirements and Schedules" Article at the end of this Section for required submittals.

PART 2 – PRODUCTS

2.1 METAL DECK UNITS

Properties:

- A. The metal deck shall conform to the following requirements:

1. Formed from galvanized steel sheets complying with ASTM A653 SS, grade 40.
2. The depth, gauge, and structural properties shall be adequate to resist all Dead, Live, and short term loading.
3. Deck supporting concrete or lightweight cementitious fill shall be vented.
4. The configuration, depth and gauge of deck shall conform to requirements noted on plans.

2.2 ACCESSORIES

- A. Provide accessories specifically designed to be used with the metal deck units, including, but not necessarily limited to, ridge and valley plates, closures, cant strips, and sump pans if required.
- B. Provide other materials, not specifically described but required for a complete and proper installation, subject to the approval of the Architect.

PART 3 – EXECUTION

3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which the Work will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Prior to start of installation, verify that beams are in proper alignment and that surfaces are clean for connections and welding.
- B. Place each metal deck unit on the supporting steel framework, and adjust to final position prior to permanent attachment and welding.
- C. Complete installation of the metal deck work in accordance with the manufacturer's recommendations.
- D. Welding shall comply with AWS D1.3.

3.3 TOUCH-UP

- A. Upon completion of installation, and as a condition of its acceptance, visually inspect each item installed and locate surfaces where finish was damaged.
 1. Touch-up galvanized surfaces with zinc-rich primer or other galvanized repair paint approved for repair purposes by the Architect.
 2. Touch-up other damaged surfaces as required to return the surfaces to the undamaged condition.

Section continued on next page

3.4 SUBMITTAL REQUIREMENTS AND SCHEDULE

- A. Include this form with submittals of this Specification Section, unless a substitution product is being proposed, in which case refer to Division 1 Section "Substitutions" for Substitution requests.

Contractor's Contractor is to acknowledge with initials each submittal included. Attach a letter of explanation for each submittal not included.

Initials

_____ All submitted products are as specified.

B. SUBMITTAL SCHEDULE:

_____ 1. Metal deck.

_____ 2. Weld washers.

_____ 3. Welded studs.

_____ 4. Closure plates.

END OF SECTION 05 31 00

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide cold-formed punched channel studs framing for exterior walls and partitions as shown and specified.

1.2 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specifications Sections.
- B. Refer to “Submittal Requirements and Schedules” Article at the end of this Section for required submittals.

1.3 QUALITY ASSURANCE

- A. System components (studs, track, blocking, etc.) shall be by a single manufacturer.
- B. Tolerance: Framing shall be plumb, even and flat to within 1/8" in 10'. Tolerance shall be non-cumulative.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Protect metal framing units from rusting and damage. Deliver to project site in manufacturer's unopened containers or bundles, fully identified with name, brand, type and grade. Store off ground in a dry ventilated space or protect with suitable waterproof coverings.

PART 2 – PRODUCTS

2.1 METAL FRAMING

- A. System Components: With metal framing required, provide manufacturer's standard steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories as recommended by manufacturer for applications indicated, as needed to provide a complete metal framing system.
- B. Materials and Finishes:
 - 1. For 16-gage and heavier units, fabricate metal framing components of structural quality

- prime steel sheet with a minimum yield point of 50,000 psi; A653.
- 2. Provide galvanized finish to metal framing components complying with ASTM A653 for minimum G60 coating.
- 3. Fasteners: Provide nuts, bolts, washers, screws, and other fasteners with corrosion-resistant plated finish.
- 4. Welding & Electrodes for Welding: Comply with AWS D1.3 and as recommended by stud manufacturer.
- 5. Galvanizing Repair: Where galvanized surfaces are damage, prepare surfaces and repair in accordance with procedures specified in ASTM A780.

- C. "C"-Shaped Studs: Manufacturer's standard steel studs of shape and gage indicated on Drawings, with 1.625 inches flange and flange return lip, unless otherwise noted on the drawings.
 - 1. Provide stud size as indicated on Drawings.
 - 2. Comply with ICC ESR-3064P.

2.2 FABRICATION

- A. General: Framing components may be prefabricated into panels prior to erection. Fabricate panels plumb, square, true to line and braced against racking with joints welded. Perform lifting of prefabricated panels in a manner to prevent damage or distortion.
- B. Fastening: Attach similar components by welding. Attach dissimilar components by welding, bolting, or screw fasteners, as standard with manufacturer. All screws shall be per Hilti [ICC ESR-2196] or ITW Buildex [ICC ESR-3223].

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Pre-Installation Conference:
 - 1. Prior to start of installation of metal framing systems, meet at Project Site with installers of other work including door and mechanical and electrical work.
 - 2. Review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.

3.2 INSTALLATION

- A. Manufacturer's Instructions: Install metal framing systems in accordance with manufacturer's printed or written instructions and recommendations, unless otherwise indicated.
- B. Runner Tracks: Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Secure tracks as recommended by stud manufacturer for type of construction involved. For interior partitions, do not exceed 48" o.c. for nail or power driven fasteners or 16" o.c. for other types of attachment. For exterior partitions, do not exceed 24"

o.c. for nail or power driven fasteners or 16" o.c. for other types of attachment. Provide fasteners at corners and ends of tracks.

- C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
- D. Where stud system abuts structural walls, including masonry walls, anchor ends of lateral stiffeners to supporting structure.
- E. Install supplementary framing, blocking and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations and industry standards in each case, considering weight or loading resulting from item supported.
- F. Installation of Wall Stud System: Secure studs to bottom runner tracks by either welding or screw fastening at both inside and outside flanges. Secure studs to top runner tracks as shown to accommodate building movement.
- G. Frame wall openings larger than 2'-0" square with double stud at each jamb of frame except where more than 2 are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of wall. Secure stud system wall opening frame in manner indicated.
- H. Frame both sides of expansion and control joints, with separate studs; do not bridge the joint with components of stud system.
- I. Install horizontal stiffeners in stud system, spaced (vertical distance) at not more than 5'-0" on center. Weld at each intersection.
- J. Field Painting: Touch-up shop-applied protective coatings damaged during handling and installation. Use compatible primer per Section 099100 for prime coated surface; use galvanizing repair paint for galvanized surfaces.

Section continued on next page

3.4 SUBMITTAL REQUIREMENTS AND SCHEDULE

- A. Include this form with submittals of this Specification Section, unless a substitution product is being proposed, in which case refer to Division 1 Section "Substitutions" for Substitution requests.

Contractor's Contractor is to acknowledge with initials each submittal included.
 Attach a letter of explanation for each submittal not included.

Initials

_____ All submitted products are as specified.

- B. SUBMITTAL SCHEDULE:

_____ 1. Physical data on each stud.

_____ 2. Framing attachments (screws, etc.)

_____ 3. Framing clips and bridging.

END OF SECTION 05 40 00

SECTION 05 52 13

PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:

1. Steel pipe.

1.2 RELATED SECTIONS

- A. Section 05 50 00, Metal Fabrications

1.3 PERFORMANCE REQUIREMENTS

- A. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

- A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing through one source from a single manufacturer.

- B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.6, "Structural Welding Code--Stainless Steel."

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of pipe and tube railings that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: 2 years.
- B. Installer's Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. -Steel Pipe and Tube Railings:
 - a. Blum, Julius & Co., Inc.
 - b. CR Laurence.
 - c. Livers Bronze.
 - d. Wagner, R & B, Inc.; a division of the Wagner Companies.
 - e. Or equal
- B. Nonshrink, Nonmetallic Grout:
 - 1. 1107 Advantage Grout by Dayton Superior Chemical & Cement Products.
 - 2. Conset Grout by ChemMasters Specialty Construction Products.
 - 3. General-Purpose Grout by Symons.
 - 4. Or equal.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.3 STEEL AND IRON

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.
- B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for all exterior installations and where indicated.

- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.4 FASTENERS

- A. General: Provide the following:

1. Steel Railings: Plated steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.

- B. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

- A. Shop Primer for Galvanized Steel: Zinc-dust, zinc-oxide primer formulated for priming zinc-coated steel and for compatibility with finish paint systems indicated, and complying with SSPC-Paint 5.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in steel, complying with SSPC-Paint 20.

2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

- G. Connections: Fabricate railings with either welded or nonwelded connections, unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 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 flux immediately.
 - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- J. Form changes in direction as follows:
 - 1. By bending or by inserting prefabricated elbow fittings.
- K. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- L. Close exposed ends of railing members with prefabricated end fittings.
- M. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 STEEL AND IRON FINISHES

- A. Galvanized Railings:
 - 1. Hot-dip galvanize steel railings, including hardware, after fabrication.
 - 2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
 - 3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
- B. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- C. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- D. Preparation for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic-phosphate process.

2.8 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

3.2 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
- C. Use of "Bondo" for finishes where applicable and for continuity of finishes is allowed.

3.4 PROTECTION

- A. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

SECTION 06 10 00 – ROUGH CARPENTRY

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Provide all labor, material, equipment and installation to complete framing and sheathing of interior walls and partitions as shown and specified.

1.3 RELATED SECTIONS

06 16 00 – Sheathing

1.4 REFERENCES

- A. The latest editions of specifications and standards referenced herein and published by the following organizations apply to the Work of this Section only to the extent specified by the reference.

APA	American Plywood Association - Visual Inspection
ASTM	American Society for Testing and Materials.
AWPA	American Wood Preservers Association
DFPA	Douglas Fir Plywood Association
ICC	International Code Council
PS	Public Standards of the U.S. Department of Commerce, Bureau of Standards
CBC STDS	2016 California Building Code Standards
WCLIB	West Coast Lumber Inspection Bureau
WWPA	Western Wood Products Association

1.5 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specifications Sections.
 - 1. Product data and current ICC Evaluation Service Reports for attachment accessories.
 - a. Framing Devices and framing connectors
 - b. Gun nails

1.6 QUALITY ASSURANCE

- A. Codes and Standards: Perform Work in compliance with applicable requirements of governing authorities having jurisdiction.
 - 1. Chapter 23A of the 2016 California Building Code (CBC).
 - 2. ANSI/AF&PA NDS-2012 National Design Specification for Wood Construction.
 - 3. Standard Grading Rules No. 17 of the WCLIB or the Standard Grading Rules of the WWPA. Lumber to have visible grade stamp of an agency certified by the WCLIB.

1.7 COORDINATION

- A. Coordinate Work of this Section with Work of other Sections to be attached to, or built into, wood framing.

PART 2 – PRODUCTS

2.1 LUMBER

- A. Moisture content: The maximum moisture content of framing lumber shall not exceed 19% just prior to enclosing or covering framing with plywood, gypsum wallboard and/or plaster. To ensure compliance, lumber up to 2 inch thick should be seasoned to a moisture content of 19% or less and be stamped “S-Dry”. Lumber over 2 inch thick may be shipped unseasoned and stamped “S-Green”.
- B. Structural lumber shall be S4S stress-marked Douglas Fir-Larch, manufactured and graded in accordance with WCLIB or WWPA, with minimum grades as follows unless noted otherwise:
 - 1. Joists & Rafters No. 1
 - 2. 4x & 6x Beams/Headers No. 1 or better
 - 3. Wall Studs No. 1
 - 4. Blocking, stripping & misc. No. 2
- C. Grade stamp: Provide lumber with each piece factory-marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade species, moisture content at time of surfacing, and mill.

2.2 ACCESSORY MATERIALS

- A. All Nails shall be common wire nails with dimensions complying with CBC Table 2304.9.1, manufacture shall conform to Fed. Spec, FF-N-1-1 and shall be hot-dipped galvanized for exterior locations, high humidity locations and for treated wood; plain finish for other interior locations; size and type to suit application.
 - 1. Box nails and/or “Sinker” nails are not acceptable for Work shown and/or detailed on the Structural Drawings.
- B. Bolts, Nuts and Washers conforming to ASTM A-307 shall be hot-dipped galvanized for

exterior locations, high humidity locations and treated wood; plain finish for other interior locations.

- C. Anchor Bolts: ASTM A 307, non-headed type.
- D. Lag Screws, Lag Bolts, Pins and Wood Screws: Sized to suit application: hot-dipped galvanized for exterior locations, high humidity locations and treated wood; plain finish for other interior locations. Comply with NDS Section 11.1.3.
- E. Framing connectors: current ICC Evaluation Services Report, sized and profiled to suit application; hot-dipped galvanized finish, manufactured by Simpson Strong-Tie Company, KC Metals, or approved equal.
- F. Gun Nails: Use Common Nails or current ICC Evaluation Services Report special gun nails of the same wire diameter and length as common nails specified on the Drawings. Box nails and/or "Sinker" nails are not acceptable for Work shown on the Structural Drawings.
- G. Drypack: Cement/sand drypack composed of one part cement to 3 parts sand. Dry mix first then add with only enough water to hold the mix together. Drypack required under sills as noted on the Drawings.

2.3 WOOD TREATMENT

- A. Wood Preservative (Pressure Treatment): Chromated zinc chloride or Wolman salts for pressure treated members.
- B. Pressure treatment of Douglas Fir-Larch plates, nailers, ledgers and other exposed wood structures, shall be in accordance with the AWPAs standards for the purchase and preservation of treated timber, with a retention of a least 0.35 lb. Wolman salts, 0.75 lb chromated zinc chloride per cubic feet of lumber, or 0.30 lb. per cubic foot of Pentachlorophenol type "C" light solvent. In exposed conditions, the incising of the lumber shall be waived.
 - 1. See Architectural Drawings for treatment of trellis members.
- C. Wood Preservative (Surface Application): Clear, manufactured by Woodlife, "Res" or equal.

PART 3 – EXECUTION

3.1 WOOD TREATMENT

- A. Shop pressure treat and deliver to the site ready for installation all wood materials requiring pressure impregnated preservatives.
- B. Treat site-sawn ends and holes in pressure treated lumber.

1. Apply preservative treatment in accordance with manufacturer's instruction.
2. Allow site applied preservative to cure prior to erecting members.

3.2 FRAMING

- A. Layout, cutting and installation of framing shall be under the continuous supervision of a full-time carpenter foreman experienced in all phases of framing construction and exposed architectural framing required for the Work of this Section and on the Contract Drawings.
- B. Structural members shall not be cut for pipes, conduits, ducts, etc., unless specifically noted or detailed on the Structural Drawings.
- C. Erect wood framing members true to lines and levels. Do not deviate from true alignment more than 1/4 inch. Install simple span members with crown up.
- D. Space framing members at 16 inches on center unless otherwise noted on the Drawings.
- E. Construct members of continuous pieces of longest possible lengths except as noted on the Drawings.
- F. Holes in wood for bolts shall be drilled 1/32" to 1/16" larger than the diameter of the bolt.
- G. Number of fasteners shall be as indicated on the Drawings or as noted in the ICC Evaluation Report where number of fasteners are not shown on the Drawings.
- H. Sheet metal framing connectors shown on the Drawings shall be Simpson connectors as manufactured by the Simpson Strong-Tie Company, Inc., Superspeed Connectors as manufactured by the KC Metals company or equal.
- I. Bolts shall have standard cut washers under heads and/or nuts where in contact with wood. Bolt threads shall not bear on wood.
- J. Lag bolts, lag screws and wood screws shall be screwed (not driven) into wood members. In placing lag screws or wood screws in wood, a hole of the same diameter and depth of "the solid shank" shall be bored after which the hole with a diameter equal to the diameter of the screw at the root of the thread shall be continued to a depth equal to the threaded screw length portion. Provide cut washers under the heads of lag bolts/lag screws where in contact with wood.
- K. Bolts, lag screws and wood screws shall be re-tightened prior to the application of drywall, plywood, plaster, etc.
- L. Drive nails perpendicular to grain of wood in lieu of toenailing, where feasible.
- M. For conditions not covered on the Drawings, provide penetration into the piece receiving the point of not less than 1/2 the length of the common nail or spike, provided, however, that 16d nails may be used to connect two pieces of two inch (nominal) thickness.

3.4 CLEAN-UP

- A. Clean up leftover materials of this Section and legally dispose off site. Dispose of pressure-treated wood in an authorized disposal area. Burning of materials on the Site is prohibited. Do not bury material and/or wood of any type on the job site.

END OF SECTION 06 10 00

SECTION 06 16 00 - SHEATHING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Provide all labor, material, equipment and installation to complete framing and sheathing of roof overlay, top of interior lids, mezzanine flooring, stairs and wall paneling in electrical and communications rooms as shown and specified.

1.3 RELATED SECTIONS

Section 06 10 00 – Rough Carpentry

1.4 REFERENCES

- A. The latest editions of specifications and standards referenced herein and published by the following organizations apply to the Work of this Section only to the extent specified by the reference.

APA	American Plywood Association - Visual Inspection
ASTM	American Society for Testing and Materials.
AWPA	American Wood Preservers Association
DFPA	Douglas Fir Plywood Association
ICC	International Code Council
PS	Public Standards of the U.S. Department of Commerce, Bureau of Standards
CBC STDS	2016 California Building Code Standards
WCLIB	West Coast Lumber Inspection Bureau
WWPA	Western Wood Products Association

1.5 SUBMITTALS

- A. General: Submit the following according to Conditions of Contract and Division 1 Specifications Sections.
- B. Product data and current ICC Evaluation Service Reports for attachment accessories.
 - 1. Framing Devices and framing connectors

2. Gun nails.

C. Environmental Submittal:

Reference Standard: U.S. Green Building Council (USGBC) LEED Reference Guide for Green Building Design and Construction (NC), 2009 Edition.

1. LEED Credit MR 4: Product Data for products having recycled content, documentation indicating percentages by weight of post-consumer and pre-consumer recycled content.
2. LEED Credit IEQ 4.4: Provide documentation that all composite wood and agrifiber products including core materials and all laminating adhesives, on site or shop applied, contain no added urea-formaldehyde resins.

1.6 QUALITY ASSURANCE

A. Codes and Standards: Perform Work in compliance with applicable requirements of governing authorities having jurisdiction.

1. Chapter 23A of the 2016 California Building Code (CBC).
2. ANSI/AF&PA NDS-2012 National Design Specification for Wood Construction.
3. Standard Grading Rules No. 17 of the WCLIB or the Standard Grading Rules of the WWPA. Lumber to have visible grade stamp of an agency certified by the WCLIB.
4. Structural plywood: DOC Product Standard PS 1. Plywood shall be grade marked by DFPA, TECO, APA or PTL.

B. Plywood Machine Nailing: The use of machine nailing is subject to a satisfactory jobsite demonstration of each Project and the approval by the Architect and the Project Inspector. Approval is subject to continued satisfactory performance. If nail heads penetrate the outer ply more than would be normal for a hand hammer or if minimum allowable edge distances are not maintained, the performance of this application method will be deemed unsatisfactory.

1.7 COORDINATION

A. Coordinate Work of this Section with Work of other Sections to be attached to, or built into, wood framing.

PART 2 – PRODUCTS

2.1 SHEET MATERIALS

A. Plywood shall conform to:

1. All roof, floor and wall sheathing shall be APA rated Structural I plywood of the thickness shown on the Structural Drawings.

- B. Grade stamp: Provide lumber with each piece factory-marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade species, moisture content at time of surfacing, and mill.
- C. Environmental Requirement: All composite wood and agrifiber products including core materials and all laminating adhesives, on site or shop applied, must contain no added urea-formaldehyde resins.

2.2 ACCESSORY MATERIALS

- A. All nails shall be common wire nails per ASTM F1667 with dimensions complying with CBC Table 2304.9.1, manufacture shall conform to Fed. Spec, FF-N-1-1 and shall be hot-dipped galvanized for exterior locations, high humidity locations and for treated wood; plain finish for other interior locations; size and type to suit application.
 - 1. Box nails and/or “Sinker” nails are not acceptable for Work shown and/or detailed on the Structural Drawings.
- B. Framing connectors: current ICC Evaluation Services Report, sized and profiled to suit application; hot-dipped galvanized finish, manufactured by Simpson Strong-Tie Company, KC Metals, or approved equal.
- C. Gun Nails: Use Common Nails or current ICC Evaluation Services Report special gun nails of the same wire diameter and length as common nails specified on the Drawings. Box nails and/or “Sinker” nails are not acceptable for Work shown on the Structural Drawings.

2.3 WOOD TREATMENT

- A. Wood Preservative (Pressure Treatment): Chromated zinc chloride or Wolman salts for pressure treated members.
- B. Wood Preservative (Surface Application): Clear, manufactured by Woodlife, “Res” or equal.

PART 3 – EXECUTION

3.1 FRAMING

- A. Layout, cutting and installation of framing shall be under the continuous supervision of a full-time carpenter foreman experienced in all phases of framing construction and exposed architectural framing required for the Work of this Section and on the Contract Drawings.
- B. Structural members shall not be cut for pipes, conduits, ducts, etc., unless specifically noted or detailed on the Structural Drawings.

- C. Erect wood framing members true to lines and levels. Do not deviate from true alignment more than 1/4 inch. Install simple span members with crown up.
- D. Construct members of continuous pieces of longest possible lengths except as noted on the Drawings.
- E. Number of fasteners shall be as indicated on the Drawings or as noted in the ICC Evaluation Report where number of fasteners are not shown on the Drawings.
- F. Sheet metal framing connectors shown on the Drawings shall be Simpson connectors as manufactured by the Simpson Strong-Tie Company, Inc., Superspeed Connectors as manufactured by the KC Metals company or equal.
- G. Drive nails perpendicular to grain of wood in lieu of toenailing, where feasible.
- H. For conditions not covered on the Drawings, provide penetration into the piece receiving the point of not less than 1/2 the length of the common nail or spike, provided, however, that 16^d nails may be used to connect two pieces of two inch (nominal) thickness.

3.2 PLYWOOD SHEATHING

- A. Plywood sheathing shall be laid/placed with face grain perpendicular to supports. Secure plywood sheets over firm bearing with end joints staggered.
 - 1. Provide a 1/8 inch gap between plywood edges for wall sheathing for expansion and contraction. Do not force panels into place.
 - 2. Sheathing: Provide 3x flat edge blocking for unsupported edges.
- B. Plywood sheathing shall be nailed with common wire nails spaced at 3/8" from all edges. Refer to the Drawings for nail size and spacing requirements for all plywood sheathing.
- C. Use plywood panels larger than eight square feet and greater than 24" in the least dimension.

3.4 CLEAN-UP

- A. Clean up leftover materials of this Section and legally dispose off site. Dispose of pressure-treated wood in an authorized disposal area. Burning of materials on the Site is prohibited. Do not bury material and/or wood of any type on the job site.

END OF SECTION 06 11 00

SECTION 07 54 00

THERMOPLASTIC MEMBRANE ROOFING

PART 1 - GENERAL

The work includes but is not necessarily limited to the tear off then installation of an Adhered Roofing System including membrane, flashings and other components.

1.1 SUMMARY

- A. Section Includes
 - 1. Temporary PVC Roofing
 - 2. Tear off of existing roof system
 - 3. ¼ Cover-board
 - 4. #12 Fasteners and Coverboard Plates
 - 5. Roof Membrane
 - 6. Adhesive for membrane attachment
 - 7. Fasteners and termination accessories
 - 8. Edge Metal and fasteners
 - 9. Roof Membrane Flashings
 - 10. Adhesive for Flashings
 - 11. Other Metal Flashings
 - 12. Sealants

1.2 SUBMITTALS

- A. At the time of award the Applicator will submit to the Owner (or Representative) the following (submittals of equals are to be submitted prior to the time of bid by the applicator only):
 - 1. Copies of Specification.
 - 2. Samples of each primary component to be used in the roof system and the manufacturer's current literature for each component.
 - 3. Sample copy of the warranty.
 - 4. Evidence that the proposed roof system meets the requirements of the local building code and has been tested and approved or listed by the required test organizations.
 - 5. Sample copy of Applicator's warranty.
 - 6. EPD's for the roofing membrane
 - 7. Safety Data Sheets (SDS)

1.3 QUALITY ASSURANCE

- A. Track Record – Install only PVC Roofing systems from manufacturers able to demonstrate the product on 5 existing functional roofs =>20-year-old roofs within 200 miles of the proposed project.
- B. Use only a Manufacturer who has initiated a post-consumer recycling program and can demonstrate a minimum of five projects where the existing PVC roof has been removed and recycled into new roofing membrane or PVC components.
- C. Use only a Manufacturer certified ISO 14001.
- D. Use only a Roofing Contractor who has a minimum of 5 years' experience installing the specified roofing system prior to bid date.
- E. Unreinforced or polyester reinforced membrane flashings are prohibited.
- F. No "Private Label" or third-party membrane manufacturers.
- G. No deviation from the Project Specification or the approved shop drawings is permitted without prior written approval by the Owner, the Owner's Representative and Manufacturer.
- H. Only Applicator personnel trained and authorized by manufacturer are permitted to complete work pertaining to the installation of membrane and flashings.
- I. Verify the roof deck and roof construction is structurally sound to provide support for the new roof system.
- J. The Manufacturer must provide interim and final roof inspection from a directly employed dedicated team of experienced inspectors. Sales personnel may not be used for on site inspection of installations.

1.4 REGULATORY REQUIREMENTS

These requirements are minimum standards and no roofing work will start without written documentation of the system's compliance, as required in the "Submittals" section of this specification.

- A. Factory Mutual Research Corporation (FM) - Norwood, MA
 - 1. Class 1-90
- B. Underwriters Laboratories, Inc. - Northbrook, IL
 - 1. Class A assembly

1.5 PRE-INSTALLATION MEETINGS

- A. A pre-construction conference to be attended by the Applicator, Owner's Representative and Manufacturer(s).
- B. Discuss all aspects of the project including but not limited to:
 - 1. Safety
 - 2. Set Up
 - 3. Construction Schedule
 - 4. Contract Conditions
 - 5. Coordination of the work.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver all products to the job site in the original unopened containers or wrappings bearing all seals and approvals.
- B. Handle all materials to prevent damage. Place all materials on pallets and fully protect from moisture.
- C. Store membrane rolls lying down on pallets and fully protected from the weather with clean canvas tarpaulins. Un-vented polyethylene tarpaulins are not accepted due to the accumulation of moisture beneath the tarpaulin in certain weather conditions that may affect the ease of membrane weldability.
- D. Store all adhesives at temperatures between 40° F and 80° F. Read instructions contained on adhesive canister for specific storage instructions
- E. Store all flammable materials in a cool, dry area away from sparks and open flames. Follow precautions outlined on containers or supplied by material manufacturer/supplier.
- F. All materials which are determined to be damaged by the Owner's Representative or manufacturer are to be removed from the job site and replaced at no cost to the Owner.

1.7 PROJECT CONDITIONS

- A. Check the underside of deck for possible hazards that might be in the way of fasteners.
- B. Materials may be installed under certain adverse weather conditions but only after consultation with manufacturer, as installation time and system integrity may be affected.

- C. Install only as much of the new roofing as can be made weathertight each day. Heat weld all seams before leaving the job site that day.
- D. Schedule and execute all work without exposing the interior building areas to the effects of inclement weather.
- E. All surfaces to be dry before installing insulation, Cover board, membrane or flashings. Dry the surface prior to application as required.
- F. Secure all new and temporary construction, including equipment and accessories, to preclude wind blow-off and roof or equipment damage.
- G. Install uninterrupted waterstops at the end of each day's work. Completely remove before proceeding. Waterstops must not emit dangerous or unsafe fumes and shall not remain in contact with the finished roof as the installation progresses.
- H. Prior to and during application, remove all dirt, debris and dust.
- I. Follow all safety regulations as required by OSHA and any other applicable authority having jurisdiction.
- J. Immediately take all roofing, insulation, flashings and metal work removed during construction to a legal dumping area authorized to receive such materials. Hazardous materials, such as materials are to be removed and disposed of in strict accordance with applicable City, State and Federal requirements.
- K. Immediately remove all new roofing waste material (i.e., scrap roof membrane, empty cans of adhesive) and properly transport to a legal dumping area authorized to receive such material.
- L. Take precautions that storage and/or application of materials and/or equipment does not overload the roof deck or building structure.
- M. Take precautions that storage and/or application of materials and/or equipment does not overload the roof deck or building structure.
- N. The Roofing Contractor is cautioned that certain PVC membranes are incompatible with asphalt, coal tar, heavy oils, roofing cements, creosote and some preservative materials. No contact with such materials and standard single-ply membranes. Consult Manufacturer regarding compatibility, precautions and recommendations.

1.8 SEQUENCING

- A. Arrange work sequence to avoid use of newly constructed roofing as a walking surface or for equipment movement and storage. Where such access is absolutely required, provide all necessary protection and barriers to segregate the work area and to prevent damage to adjacent

areas. Provide a substantial protection layer consisting of plywood over Sarnafelt or plywood over insulation board for all roof areas that receive rooftop traffic during construction.

1.9 WARRANTY

- A. Upon successful completion of work the following warranties must be provided:
 - 1. 20 Year System Warranty
 - 2. 2 Year Roofing Contractor Warranty
- B. System Warranty (only products purchased from single manufacturer are covered under System Warranty)
 - 1. Upon successful completion of the work to manufacturer's satisfaction and receipt of final payment, manufacturer will issue a System Warranty which includes all fasteners, cover board, accessories and covers wind speeds up to 60 mph
- C. Applicator/Roofing Contractor Warranty
 - 1. Supply the Owner with a separate workmanship warranty. In the event any work related to roofing, flashing, or metal is found to be within the Applicator warranty term, defective or otherwise not in accordance with the Contract Documents, at no cost to the Owner the Applicator will repair the defect. The warranty obligation of the Applicator is directly to the Owner, and a copy is to be sent to membrane manufacturer.
- D. Owner Responsibility
 - 1. If any leaks occur during the time period when both warranties are in effect the Owner will notify both manufacturer and the Applicator immediately. The Temporary roof is not warranted.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The components of the Adhered roof system are based on products of Sika Sarnafil (Sika Roofing Systems) G410 80 mil nominal – 72 mil minimum membrane.

2.2 MATERIALS

- A. Sarnafil G410 fiberglass reinforced membrane with a lacquer coating.
- B. Conform membrane to ASTM D4434 (latest version), "Standard for Polyvinyl Chloride Sheet Roofing". Classification: Type II, Grade I.
 - 1. Main Field Sheet - Sarnafil G410-18, 72 mil minimum or 80 mil nominal, thermoplastic membrane with fiberglass reinforcement.
- C. Color of Membrane - Main Field and Flashings – White

2.3 FLASHING MATERIALS

- A. Wall/Curb Flashing
 - 1. Asphalt Resistant Membrane
 - 2. G459 fiberglass reinforced membrane adhered to approved substrate using adhesive.
- B. Clad
 - 1. A PVC-coated, heat-weldable sheet metal capable of being formed into a variety of shapes and profiles. Clad is a 25 gauge, G90 galvanized metal sheet with a 20 mil unsupported PVC membrane laminated on one side. Color to be White.

2.4 COMPONENTS

- A. Coverboard
 - 1. Dens Deck Prime is provided in a 4 ft x 8 ft board size and in thickness of 1/4 inch.

2.5 ATTACHMENT COMPONENTS AND ACCESSORIES

- A. Membrane adhesive
 - 1. 2121 Adhesive: A water-based adhesive used to attach the membrane to horizontal or near-horizontal substrates.
- B. Flashing Adhesive
 - 1. Stabond Adhesive: A low VOC reactivating-type adhesive used to attach membrane to flashing substrate.
- C. Insulation/Coverboard Plates
 - 1. A specially-designed stress plate used with fasteners to attach insulation and/or roof boards directly to approved roof decks, the plate has a high-rib design to increase strength and to provide protection to the membrane underside from abrasion by the fastener head. The plate is 3 inch square or round, 26 gauge stamping of SAE 1010 steel with an AZ 55 Galvalume coating to meet Factory Mutual 4470 criteria for corrosion resistance.
- D. #12 Fasteners
 - 1. A #12 corrosion-resistant fastener used with plates to attach insulation and/or roof boards to steel or wood roof decks. Sarnafastener #12 has a modified buttress thread, a shank diameter of approximately 0.168 inch and a thread diameter of approximately 0.214 inch. The driving head has a diameter of approximately 0.435 inch with a #3 Phillips recess for positive engagement.
- E. Stop
 - 1. An extruded aluminum, low profile bar used with certain fasteners to attach to the roof deck or to walls/curbs at terminations, penetrations and at incline changes of the substrate. Stop is a 1 inch wide, flat aluminum bar 1/8 inch thick that has predrilled holes every 6 inches on center.

F. Stack Universal

1. A prefabricated stack/pipe flashing made from 0.060 inch thick membrane. Accommodates stack/pipe penetration from $\frac{3}{4}$ " to 8".

G. Corners

1. Prefabricated outside and inside flashing corners made of 0.060 inch thick membrane that are heat-welded to membrane.

2.6 WALKWAY PROTECTION

A. PVC Walk Tread

1. PVC Walk-tread: A polyester reinforced, 0.096 inch (96 mil), weldable membrane with surface embossment. Used as a protection layer from rooftop traffic.

2.7 ACCESSORIES

A. Aluminum Tape

1. A 2 inch wide pressure-sensitive aluminum tape used as a separation layer between small areas of asphalt contamination and the membrane and as a bond-breaker under the coverstrip at clad joints.

B. Multi-Purpose Tape

1. A high performance sealant tape used with metal flashings as a preventive measure against air and wind blown moisture entry.

C. Membrane Cleaner

1. A high quality VOC compliant solvent cleaner used for the general cleaning of residual asphalt, scuff marks, etc., from the membrane surface. Membrane Cleaner is also used daily to clean seam areas prior to hot-air welding in tear off or dirty conditions or if the membrane is not welded the same day it is unrolled.

2.8 SEALANTS

A. Multi-Purpose Sealant (for termination details).

B. Sika1 A (single component sealant) or equal

C. Depending on substrates, the following sealants are options for temporary overnight tie-ins:

1. Low Rise Foam Adhesive.
2. Multiple layers of roofing cement and felt.
3. Spray-applied, water-resistant urethane foam.
4. Mechanical attachment with rigid bars and compressed sealant.

2.9 TEMPORARY ROOFING

- A. Sikaplan 45 mill or greater PVC Roofing Membrane

2.10 MISCELLANEOUS FASTENERS AND ANCHORS

- A. Post-galvanized steel, aluminum or stainless steel is mandatory for all fasteners, anchors, nails, straps, bars, etc. Avoid galvanic corrosion by not mixing metal types and methods of assembly. Use expansion type fasteners with stainless steel pins for attachment of metal to masonry. A minimum embedment of 1¼ inch for all concrete fasteners and anchors and the fasteners are to be approved by the manufacturer to be used in that manner. A minimum embedment of 1 inch for all miscellaneous wood fasteners and anchors used for flashings and the fasteners are to be approved by the manufacturer to be used in that manner.

PART 3 - EXECUTION

3.1 TEMPORARY ROOFING

- A. Install PVC Temporary roof by fastening the perimeter of the membrane to the deck or walls.
- B. Use a non-bitumen tape for all seams. The Temporary roof can be laid directly on the plywood deck.
- C. It is up to the contractors involved to maintain a watertight condition.

3.2 SUBSTRATE CONDITION

- A. Acceptance or provision of proper substrate to receive new roofing materials will be by the Applicator.
- B. Verify that the work done under related sections meets the following conditions:
 - 1. Roof drains and/or scuppers have been installed properly.
 - 2. Roof curbs, nailers, equipment supports, vents and other roof penetrations are properly secured and prepared to receive new roofing materials.
 - 3. All surfaces are smooth and free of dirt, debris and incompatible materials.
 - 4. No water, ice and snow on the roof surface.

3.3 SUBSTRATE PREPARATION

- A. The roof deck and existing roof construction must be structurally sound to provide support for the new roof system. Load materials on the rooftop in such a manner as to eliminate risk of deck overload due to concentrated weight. The Owner's Representative is to verify that the roof deck

is secured to the structural framing according to local building code and in such a manner as to resist all anticipated wind loads in that location.

3.4 SUBSTRATE INSPECTION

- A. Prepare a dry, clean and smooth substrate to receive the Adhered roof system.
- B. Inspect the substrate for defects such as excessive surface roughness, contamination, structural inadequacy, or any other condition that will adversely affect the quality of work.
- C. The substrate will be clean, smooth, dry, free of flaws, sharp edges, loose and foreign material, oil and grease. Correct all defects before roofing starts.
- D. No water, ice and snow on the roof surface prior to starting.
- E. Apply membrane over compatible and accepted substrates only.

3.5 COVERBOARD INSTALLATION

- A. Install Cover board according to manufacturer's instructions and shop drawings.
 - 1. Neatly cut Cover board to fit around penetrations and projections.
 - 2. Cover all cover board membrane by the end of the day or the onset of inclement weather.
 - 3. Mechanical Fastener Attachment
 - a. Boards shall be mechanically fastened to the deck with approved fasteners and plates at a rate according to the board manufacturer's and Sika Corporation's recommendations for fastening rates and patterns. The quantity and locations of the fasteners and plates shall also cause the boards to rest evenly on the roof deck/substrate so that there are no significant and avoidable air spaces between the boards and the substrate.
 - b. Fasteners must be tight enough so plates do not turn, but not so tight as to deform them.
 - c. Fasteners are to be installed consistently in accordance with fastener manufacturer's recommendations. Fasteners are to have minimum penetration into structural deck recommended by the fastener manufacturer and Sika Corporation.
 - d. Use fastener tools with a depth locator and torque-limiting attachment as recommended or supplied by fastener manufacturer to ensure proper installation.

3.6 INSTALLATION OF MEMBRANE

Inspect the surface of the insulation or substrate prior to installation of the roof membrane. The substrate will be clean, dry, free from debris and smooth with no surface roughness or contamination. Remove and replace delaminated, wet or damaged insulation boards.

- A. VOC Compliant Adhesive:

1. Over the properly installed and prepared substrate, pour adhesive out of the pail and spread using a medium nap roller. Apply the adhesive at a rate according to manufacturer requirements. No adhesive is to be applied to the back of the membrane. Do not allow adhesive to skin-over or surface-dry prior to installation of membrane.
2. The roof membrane is unrolled immediately into the wet adhesive. Adjacent rolls overlap previous rolls by 3 inches. This process is repeated throughout the roof area. Immediately after application into adhesive, firmly press each roll into place with a water-filled, foam-covered lawn roller by frequent rolling in two directions. Do not allow adhesive to skin-over or surface-dry prior to installation of membrane.
 - a. Do not use 2121 if temperatures are below 40° F or are expected during application or subsequent drying time.
 - b. Apply no adhesive in seam areas. Apply all membrane in the same manner.
 - c. Do not use 2121 on vertical surfaces or sloped surfaces greater than a 2 inch rise per 1 horizontal foot.

3.7 HOT-AIR WELDING OF SEAM OVERLAPS

A. General

1. Hot-air weld all seams. Seam overlaps should be 3 inches wide when automatic machine-welding and 4 inches wide when hand-welding, except for certain details.
2. Manufacturer will provide or approve the welding equipment. Successful completion of a training course provided by a Manufacturer Technical Representative prior to welding by all mechanics intending to use the equipment is mandatory.
3. All membrane is to be clean and dry before welding.

B. Hand-Welding

Complete hand-welded seams in two stages. Allow hot-air welding equipment to warm up for at least one minute prior to welding.

1. Weld the back edge of the seam with a narrow but continuous weld to prevent loss of hot air during the final welding.
2. Insert the nozzle into the seam at a 45 degree angle to the edge of the membrane. Once the proper welding temperature has been reached and the membrane begins to "flow," the hand roller is positioned perpendicular to the nozzle and rolled lightly. For straight seams, the 1-1/2 inch wide nozzle is recommended for use. For corners and compound connections, use the 3/4 inch wide nozzle.

C. Machine Welding

1. Machine welded seams are achieved by the use of Sika Sarnafil's automatic welding equipment. When using this equipment, follow Sika Sarnafil's instructions and local codes for electric supply, grounding and over current protection observed. Dedicated circuit house power or a dedicated portable generator is recommended. Use no other equipment simultaneously off the generator.
2. Metal tracks may be used over the deck membrane and under the machine welder to minimize or eliminate wrinkles.

D. Quality Control of Welded Seams

1. Check all welded seams for continuity using a rounded screwdriver. Visible evidence that welding is proceeding correctly is smoke during the welding operation, shiny membrane surfaces, and an uninterrupted flow of dark grey material from the underside of the top membrane. On-site evaluation of welded seams shall be made daily by the Applicator at locations as directed by the Owner's Representative or Manufacturer's representative. Take one inch wide cross-section samples of welded seams at least three times a day. Correct welds display failure from shearing of the membrane prior to separation of the weld. Patch each test cut by the Applicator at no extra cost to the Owner.

3.8 MEMBRANE FLASHINGS

Install all flashings concurrently with the roof membrane as the job progresses. No allowance for temporary flashings without the prior written approval of the Owner's Representative and Manufacturer. Only specific locations on specific dates will be approved. If any water is allowed to enter under the newly completed roofing, remove and replace the affected area at the Applicator's expense. Adhere flashing to compatible, dry, smooth, and solvent-resistant surfaces. Use caution to ensure adhesive fumes are not drawn into the building.

- A. Adhesive for Membrane Flashings
 1. Over the properly installed and prepared flashing substrate, apply adhesive according to instructions found on the Product Data Sheet. Apply the adhesive in smooth, even coats with no gaps, globs or similar inconsistencies. Flash only an area which can be completely covered in the same day's operations. Firmly press the bonded sheet in place with a hand roller.
 2. Apply no adhesive in seam areas that are to be welded. Apply all panels of membrane in the same manner, overlapping the edges of the panels as required by welding techniques.
- B. Install stop according to the Detail Drawings with approved fasteners into the structural deck at the base of parapets, walls and curbs.
- C. Follow Manufacturer's requirements, recommendations and the specifications. Accept all material submittals prior to installation.
- D. Extend all flashings a minimum of 8 inches above roofing level unless otherwise accepted by the Owner's Representative and Manufacturer's Technical Department.
- E. Consistently adhere all flashing membranes to substrates. Cut and hot-air weld into place all interior and exterior corners and miters. No contact with bitumen and the membrane.
- F. Mechanically fasten all flashing membranes along the counter-flashed top edge with stop at 6-8 inches on center.
- G. Terminate flashings according to Manufacturer's recommended details.
- H. Add additional securement to all flashings that exceed 30 inches in height. Consult Manufacturer's Technical Department for securement method.

3.9 WALKWAY INSTALLATION

- A. Roofing membrane to receive PVC Walk-tread shall be clean and dry. Place chalk lines on deck sheet to indicate location of Walkway. Clean the deck membrane in areas to be welded. Hot-air weld the entire perimeter of the Walk-tread to the single-ply deck sheet. Check all welds with a rounded screwdriver. Re-weld any inconsistencies. Check all existing deck membrane seams that are to be covered by Walkway with rounded screwdriver and re-weld any inconsistencies before Walkway installation. Walkway will also be installed under any scupper as a protection layer from falling debris.

3.10 TEMPORARY CUT-OFF

- A. Install all flashings concurrently with the roof membrane in order to maintain a watertight condition as the work progresses. Construct all temporary waterstops to provide a 100% watertight seal. The stagger of the insulation joints will be made even by installing partial panels of insulation. Carry the new membrane into the waterstop. Seal the waterstop to the deck and/or substrate so that water will not be allowed to travel under the new or existing roofing. Seal the edge of the membrane in a continuous heavy application of sealant. When work resumes, cut out the contaminated membrane. Remove all sealant, contaminated membrane, insulation fillers, etc. from the work area and properly disposed of off site. Use none of these materials in the new work.
- B. Provide the labor necessary to monitor and maintain a watertight condition, if inclement weather occurs while a temporary waterstop is in place.
- C. If any water is allowed to enter under the newly-completed roofing, remove and replace the affected area at the Applicator's expense.

3.11 COMPLETION

- A. Prior to demobilization from the site, the work shall be reviewed by the Owner's Representative and the Applicator. All defects noted and non-compliances with the Specifications or the recommendations of the manufacturer shall be itemized in a punch list. These items must be corrected immediately by the Applicator to the satisfaction of the Owner's Representative and Manufacturer prior to demobilization.

3.12 FIELD QUALITY CONTROL

- A. Upon completion of the installation and the delivery to Manufacturer by the Applicator of a certification that all work has been done in strict accordance with the contract specifications and Manufacturer's requirements, a Technical Representative will inspect and review the installed roof system.

3.13 MANUFACTURER DEMONSTRATION

- A. Provide maintenance documents and personal instruction for the facilities staff and other interested parties at a single pre-determined mutually convenient time. The instruction shall include the following topics:
1. Access restriction and precautions
 2. Avoiding Mechanical Damage
 3. Potential Contaminants and rectification
 4. Cleaning
 5. Emergency repairs
 6. Procedures for permanent repairs and alterations

END OF SECTION

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SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sheet metal flashing and trim not specifically specified in other sections.
- B. Related Sections:
 - 1. Division 6 Section "Rough Carpentry" for wood nailers, curbs, and blocking.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
 - 1. Identification of material, thickness, weight, and finish for each item and location in Project.
 - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
 - 3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 - 4. Details of termination points and assemblies, including fixed points.
 - 5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.

6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
7. Details of special conditions.
8. Details of connections to adjoining work.

1.5 QUALITY ASSURANCE

- A. Reference Standards:
 1. 2016 Building Standards Administrative Code, Part 1, Title 24 C.C.R.
 2. 2016 California Building Code (CBC), Part 2, Title 24 C.C.R. (2015 International Building Code (IBC) & 2016 California Amendments).
 3. 2016 California Mechanical Code (CMC), Part 4, Title 24 C.C.R. (2015 Uniform Mechanical Code & 2016 California Amendments).
 4. 2016 California Green Building Standards Code (CALGreen), Part 11, Title 24 C.C.R.
 5. 2016 California Referenced Standards, Part 12, Title 24 C.C.R..
- B. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- C. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.
- B. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653, G90 coating designation; structural quality.
 2. Surface: Smooth, flat and mill phosphatized for field painting.

3. Color: As selected by Architect from manufacturer's full range.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.2 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- G. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.3 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with interlocking counterflashing on exterior face, of same metal as reglet.
 1. Products:
 - a. Fry Reglet Corporation.
 - b. Heckmann Building Products Inc.

- c. Hickman, W. P. Company.
 - d. Hohmann & Barnard, Inc.; STF Sawtooth Flashing.
 - e. Or equal.
- 2. Material: Galvanized steel, minimum 0.022 inch thick.
- 3. Provide one of the following types depending on substrates:
 - a. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
 - b. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
 - c. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
 - d. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
 - e. Accessories:
 - 1) Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
 - 2) Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

2.4 FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
 - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 2. Obtain field measurements for accurate fit before shop fabrication.
 - 3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
- G. Do not use graphite pencils to mark metal surfaces.

2.5 ROOF DRAINAGE SHEET METAL FABRICATIONS

- A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.
 - 1. Gutter Style: SMACNA designation and as indicated on drawings.
- B. Overflow Parapet Scuppers:
 - 1. Size: Three times the size of roof drains.
 - 2. Opening: Minimum opening height of 4 inches with inlet flow line located 2 inches above low point of adjacent roof.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 5. Install sealant tape where indicated.
 6. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
- C. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- D. Seal joints as shown and as required for watertight construction.
1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
 2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

3.3 ROOF DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.
- B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets spaced not more than 36 inches apart. Provide end closures and seal watertight with sealant. Slope to downspouts.

3.4 MISCELLANEOUS FLASHING INSTALLATION

- A. Overhead-Piping Safety Pans: Suspend pans independent from structure above as indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.
- B. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.6 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07620

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SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Sealants and joint backing.

1.2 RELATED SECTIONS

1.3 DEFINITIONS

- A. Based on ASTM C 920 Substrates:
 - 1. M type substrates: Concrete, concrete masonry units, brick, mortar, natural stone. The term "masonry" means brick, stone, and concrete masonry work.
 - 2. G type substrates: Glass and transparent plastic glazing sheets.
 - 3. A type substrates: Metals, porcelain, glazed tile, and smooth plastics.
 - 4. O type substrates: Wood, unglazed tile; substrates not included under other categories

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.
- C. Samples: Submit two samples, 6 inch long illustrating sealant colors for selection.
- D. Color selection: Color selection shall be made from manufacturers standard color selection. Selection shall be made by Architect.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Sustainable Design Submittals: Provide the following information
 - 1. Low Emitting Materials

1.5 QUALITY ASSURANCE

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

- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years of experience.

1.6 FIELD CONDITIONS

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

1.7 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 - PRODUCTS

2.1 SEALANTS

- A. Sealants and Primers - General: Provide only products having lower volatile organic compound (VOC) content than required by South Coast Air Quality Management District Rule No. 1168.
- B. Type SJ-1 - General Purpose Exterior Sealant: Silicone, nonstaining, S, NS, 50, NT.
 - 1. Applications: Use for:
 - a. Control, expansion, and soft joints in masonry.
 - b. Joints between concrete and other materials.
 - c. Joints between metal frames and other materials.
 - d. Other exterior joints for which no other sealant is indicated.
- C. Type SJ-2 - Exterior Expansion Joint Sealer: Multi-component self-leveling polyurethane sealant, ASTM C 920, Type M, Grade P, Class 25, Use T.
 - 1. Size as indicated on drawings, if not detailed, then per manufacturer's recommendation to provide weathertight seal when installed.
 - 2. Provide product recommended by manufacturer for traffic-bearing use.
 - 3. Applications: Use for:
 - a. Exterior horizontal joints in concrete flatwork and extruded curbs.
- D. Type SJ-3 - Silicone Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, Uses NT, A, G; single component, solvent curing, non-sagging, non-staining, non-bleeding.

1. Color: Match adjacent finished surfaces.
 2. Movement Capability: Plus 100 percent, minus 50 percent.
 3. Service Temperature Range: -65 to 180 degrees F.
 4. Shore A Hardness Range: 15 to 35
 5. Applications: Use for:
 - a. Glazing at aluminum frames.
- E. Type SJ-4 - Exterior Metal Lap Joint Sealant: One-part non-sag silyl terminated polyether sealant: ASTM C-920, Type S. Grade NS, Class 25, Use NT, T, M, G, A, O.
1. Applications: Use for:
 - a. Concealed sealant bead in sheet metal work.
- F. Type SJ-5 - General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, Type OP, Grade NF single component, paintable.
1. Color: To be selected by Architect from manufacturer's standard range.
 2. Applications: Use for:
 - a. Interior wall and ceiling control joints.
 - b. Joints between door and window frames and wall surfaces.
 - c. Interior joint sealant between window frames and wall or curb below
 - d. Other interior joints for which no other type of sealant is indicated.
- G. Type SJ-6 - Bathtub/Tile Sealant: White silicone; ASTM C920, Uses I, M and A; single component, mildew resistant.
1. Applications: Use for:
 - a. Joints between plumbing fixtures and floor and wall surfaces.
 - b. Joints between countertops with faucets and wall surfaces and backsplash.
- H. Type SJ-7 - Acoustical Sealant: Non-skinning, sound dampering; single component, solvent release curing, non-skinning.
1. Applications: Use for concealed locations only:
 - a. Sealant bead between top stud runner and structure and between bottom stud track and floor.

2.2 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM 0 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width; Backer Rod manufactured by Backer Rod Manufacturing, Inc., Denver, CO.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Install bond breaker where joint backing is not used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- G. Tool joints concave.
- H. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.
- I. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal all joints with adhesive; install with face 1/8 to 1/4 inch below adjoining surface.

3.4 CLEANING

- A. Clean adjacent soiled surfaces.

3.5 PROTECTION

- A. Protect sealants until cured.

3.6 SCHEDULE

- A. Control and Expansion Joints in Paving: Type SJ-2.
- B. Joints Between Concrete Panels and Between Panels and Adjacent Work: Type SJ-1.
- C. Control Expansion, and Soft Joints in Masonry, and Between Masonry and Adjacent Work: Type SJ-1.
- D. Lap Joints in Exterior Sheet Metal Work: Type SJ-4.
- E. Joints Between Exterior Metal Frames and Adjacent Work (except masonry): Type SJ-1.
- F. Joints Between Interior Metal Frames and Adjacent Work (except masonry): Type SJ-5.
- G. Under Exterior Door Thresholds: Type SJ-4.
- H. Interior Joints for Which No Other Sealant is Indicated: Type SJ-5; None; N/A.
- I. Control and Expansion Joints in Interior Concrete Slabs and Floors: Type SJ-2.
- J. Joints Between Plumbing Fixtures and Walls and Floors, and Between Countertops and Walls: Type SJ-6.
- K. In Sound Rated Walls, Between Metal Stud Track/Runner and Adjacent Construction: Type SJ-7.

END OF SECTION

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SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Non-fire-rated steel doors and frames.
- B. Steel frames for wood doors.
- C. Fire-rated steel doors and frames.
- D. Thermally insulated steel doors.
- E. Accessories, including louvers.

1.2 RELATED SECTIONS

1.3 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.
- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- E. Manufacturer's Certificate: Certification that products including STC rating of sound doors meet or exceed specified requirements.
- F. Sustainable Design Submittals: Provide the following information
 - 1. Local/Regional Materials
 - 2. Recycled Materials

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Maintain at the project site a copy of all reference standards dealing with installation.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store in accordance with NAAMM HMMA 840.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Steel Doors and Frames:
 - 1. Steelcraft: www.steelcraft.com. (Basis of Design)
 - 2. Assa Abloy Ceco, Curries, or Fleming: www.assaabloydss.com.
 - 3. Door Components Inc.; www.doorcomponents.com
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 DOORS AND FRAMES

- A. Requirements for Doors and Frames:
 - 1. Accessibility: Comply with CBSC 2016.
 - 2. Door Top Closures: Flush with top of faces and edges.
 - 3. Door Edge Profile: Beveled on both edges.
 - 4. Door Texture: Smooth faces.
 - 5. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard.
 - 6. Galvanizing for exterior units: All components hot-dipped zinc-iron alloy-coated (galvannealed), manufacturer's standard coating thickness.
 - 7. Finish: Factory primed, for field finishing.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.3 STEEL DOORS

- A. Exterior Doors: 16 GA L Series Doors by Steelcraft
 - 1. Grade: ANSI A250.11 Level 4, physical performance Level A, Model 2, seamless.
 - 2. Core: 1" cell, 99 pound Kraft Honeycomb core
 - 3. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
 - 4. Insulating Value: U-value of 0.70, when tested in accordance with ASTM C 1363.
- B. Interior Doors, Non-Fire-Rated: 18 L Series Doors by Steelcraft
 - 1. Grade: ANSI A250.8 Level 3, physical performance Level A, Model 2, seamless.
 - 2. Core: 1" cell, 99 pound Kraft Honeycomb core.
 - 3. Thickness: 1-3/4 inches.
- C. Interior Doors, Fire-Rated: 18 L Series Doors by Steelcraft
 - 1. Grade: ANSI A250.8 Level 3, physical performance Level A, Model 2, seamless.
 - 2. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with UL 10C ("positive pressure").
 - a. Provide units listed and labeled by UL.
 - b. Attach fire rating label to each fire rated unit.
 - 3. Core: As required to meet Fire-Rated assembly.

2.4 STEEL FRAMES

- A. General:
 - 1. Comply with the requirements of grade specified for corresponding door, except:
 - a. ANSI A250.11: 18 gage frames.
 - b. ANSI A250.11: 16 gage frames.
 - c. Frames for Wood Doors: Comply with frame requirements specified in ANSI A250.8 for Level 2
 - 2. Finish: Factory primed, for field finishing.
 - 3. Frames Wider than 48 Inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
 - 4. Frames Installed Back-to-Back: Reinforce with steel channels anchored to floor and overhead structure.
- B. Exterior Door Frames: Continuous face welded, dressed and grind smooth.
 - 1. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
 - 2. Weatherstripping: Integral, recessed into door edge or frame.
- C. Interior Door Frames, Non-Fire-Rated: Continuous face welded, dressed and grind smooth.
- D. Interior Door Frames, Fire-Rated: Continuous face welded, dressed and grind smooth. 1. Fire Rating: Same as door, labeled.

2.5 ACCESSORY MATERIALS

- A. Louvers: Roll formed steel with overlapping frame; finish same as door components; factory-installed.
 - 1. In Fire-Rated Doors: UL-listed fusible link louver, same rating as door.
 - 2. Style: Sightproof inverted V blade.
 - 3. Louver Free Area: 60 percent.
 - 4. Manufacturer: Anemostat Door Products, Model CHDL-2F or equal.
- B. Astragals for Double Doors: Specified in Section 08 71 00.
 - 1. Fire-Rated Doors: Steel, shape as required to accomplish fire rating.
- C. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- D. Temporary Frame Spreaders: Provide for all factory- or shop-assembled frames.

2.6 FINISH MATERIALS

- A. Primer: Rust-inhibiting, complying with ANSI A250.1 0, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.
- C. Colors and coating to match custom samples provided by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

3.2 PREPARATION

- A. Coat inside of frames to be installed in concrete or to be grouted, with bituminous coating, prior to installation.

3.3 INSTALLATION

- A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA840.
- B. In addition, install fire rated units in accordance with NFPA 80.

- C. Coordinate frame anchor placement with wall construction.
- D. Coordinate installation of hardware.
- E. Coordinate installation of electrical connections to electrical hardware items.
- F. Touch up damaged factory finishes.

3.4 TOLERANCES

- A. Clearances Between Door and Frame: As specified in ANSI A250.8.
- B. Maximum Diagonal Distortion: 1/16 in measured with straight edge, corner to corner.

3.5 ADJUSTING

- A. Adjust for smooth and balanced door movement.
- B. Adjust sound control doors so that seals are fully engaged when door is closed.
- C. Test sound control doors for force to close, latch, and unlatch in accordance with ASTM E1408; adjust as required to comply.

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SECTION 08 41 00

ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass and spandel glass.
- B. Aluminum-framed glass doors.
- C. Mullion covers, subframes, reinforcement and anchors, and sealants for the work of this Section.
- D. Work installed but furnished in other Sections: Division 08 for finish hardware on doors.
- E. Perimeter sealant.
- F. Related Sections:
 - 1. Section 01 35 43, Special Environmental Requirements.
 - 2. Energy calculations or prescriptive compliance documents.
 - 3. Section 08 80 00, Glazing

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.3 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage, glass, internal drainage details and fasteners and self-drilling fasteners.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
 - 1. Large scale dimensioned shop and erection drawings for the work of this Section showing interface with adjacent materials/assemblies, expansion provisions, glazing details, and hardware mounting heights.

2. Show relative layout of adjacent construction and identify shop and field sealants by product name and locate on shop drawings.
3. Layout drawings:
 - a. Submit drawings for fasteners and anchors to be embedded in concrete showing type of fixing, location, setting-out dimensions and acceptable setting tolerances.
 - b. Provide complete floor plans, elevations (if required) and full size details of the embedded anchorage for review along with a fully coordinated set of structural calculations.
 - c. Details of each type of embedded anchor and/or fixing shall be included within this submittal.
 - d. Draw details full size with complete notes.
 - e. Areas of the building to which the work of this Section is attached with embedded anchorage shall be identified and included.
 - f. Areas of the building to which the work of this Section will be attached without the use of embedded anchorage shall also be identified.
- D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, dimensional limitations.
- E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- F. Samples: Submit two samples 3 by 4 inches in size illustrating finished aluminum surface glass glazing materials.
- G. Samples: Submit two samples 6 x 6 inches in size illustrating finished aluminum surface, glazing materials.
- H. Sustainable Design Submittals: Provide the following information
 1. Local/Regional Materials
 2. Recycled Materials
 - a. Float glass manufacturing feedstock materials are scrutinized as part of a quality process given the sensitive nature of glass production. It is common for manufacturers to produce scrap glass, called cullet, which is stockpiled and then reprocessed and reutilized into the manufacturing process. The range of cullet typically comprises between 10%- 20% of the final manufactured glass product, this should be verified with the manufacturer. Because cullet is generated at the manufacturing site, the chemical make-up of the cullet is known, and it can be sorted and stockpiled appropriately prior to reutilization as feedstock. If cullet is being claimed toward recycled content, it should be determined that the cullet is being fed from the end of a production line (as waste in the production process) back into the beginning of the same line. This should be noted in the special environmental requirements product form.
- I. Calculations: Prepare calculations in compliance with current design rules of AA, AISC, and AISI. Include analysis for wind and dead load on framing members, anchors, and concrete inserts.
 1. Show section property computations for framing members. Show vertical and horizontal loads on curbs and other supports. Existing test reports will be acceptable substitute for

- calculations. Calculations shall be signed and sealed by a California-licensed professional engineer.
 - 2. Do not increase allowable stresses or decrease applied loads for design wind loads, or wind loads in combination with other loads, where not permitted by Code, or if resultant allowable stress after increase is greater than or equal to yield stress.
 - 3. Certified test results: Certified test results showing that assemblies have been tested by a recognized testing laboratory or agency and comply with specified performance characteristics.
- J. Report of field testing for water leakage.
- K. Warranty: Submit manufacturer warranty and ensure forms have been completed in College District's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at California.
- B. Engineering responsibility:
- 1. Engineer, fabricate, assemble and erect the work of this Section to meet or exceed the specified design and performance criteria, and to provide watertight, structurally sound, self-draining assembly conforming to governing codes and regulations.
 - 2. The assemblies shown on the Drawings and specified herein are intended to define design intent and minimum performance requirements. Do not change indicated profiles without the Architect's written consent.
- C. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum five years of documented experience.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.6 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.7 WARRANTY

- A. See Section 01 33 00 - Submittal Requirement for additional warranty requirements.

- B. Correct defective Work within a ten year period after Date of Substantial Completion.
- C. Provide ten year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide twenty year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.
 - 1. "Excessive fading": A change in appearance which is perceptible and objectionable as determined by the Architect when viewed visually in comparison with the original color range standards.
 - 2. "Excessive non-uniformity": Non-uniform fading during the period of the guarantee to the extent that adjacent parts have a color difference greater than the original acceptable color range.
 - 3. "Will not pit or otherwise corrode": There shall be no pitting or other type of corrosion discernible from a distance of 10-foot, resulting from the natural elements in the atmosphere at the Project site.
 - 4. Sealants: Refer to Section 07 92 05.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Kawneer North America.
- B. Other Acceptable Manufacturers:
 - 1. Oldcastle Building Envelope, www.oldcastlebe.com.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 STOREFRONT

- A. Exterior Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Glazing Rabbet: For 1 inch insulating glazing.
 - 2. Glazing Position: Front-set.
 - 3. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.
 - 4. Design Wind Load: See structural drawings.
 - 5. Water Leakage Test Pressure Differential: 8.00 lbf/sq ft.
 - 6. Air Infiltration Test Pressure Differential: 1.57 psf.
 - 7. Product: Trifab 451 VG.
 - 8. Finish: Superior performance organic coating.
 - 9. Color: As selected from manufacturer's standards.
- B. Interior Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Glazing Rabbet: For 1/4 inch monolithic glazing.
 - 2. Glazing Position: Centered (front to back).
 - 3. Vertical Mullion Dimensions: 1-3/4 inches wide X 4-1/2 inches deep.

4. Air Infiltration Test Pressure Differential: 1.57 psf.
5. Product: Trifab 451 VG.

2.3 DESIGN CRITERIA

- A. Structural loads:
1. Wind loads: As indicated on Drawings.

2.4 PERFORMANCE REQUIREMENTS

- A. Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
1. Dead loads:
 - a. Provide glazing members that will not deflect an amount, which will reduce glazing bite below 75 percent of design dimension when carrying full dead load.
 - b. Provide a minimum 1/8-inch clearance between members and top of glazing or other fixed part immediately below.
 - c. Provide a minimum 1/16-inch clearance between members, operable windows, and doors.
 2. Live loads: Provide assemblies, including anchorage, that accommodate the supporting structure deflection from uniformly distributed and concentrated live loads indicated without failure of materials or permanent deformation.
 3. Design Wind Loads: Comply with requirements of California Building Code.
 4. Wind loads:
 - a. Provide assemblies in exterior walls, including anchorage, capable of withstanding wind-load design pressures indicated on the Structural Drawings, acting inward and outward.
 - b. Provide interior assemblies, including anchorage, capable of withstanding a lateral pressure of not less than 5 psf.
 - c. Limit deflection of framing members in a direction normal to wall plane to 1/175 of clear span or 3/4-inch, whichever is smaller.
 - d. Static-pressure test performance (exterior assemblies): Provide assemblies that do not evidence material failures, structural distress, failure of operating components to function normally, or permanent deformation of main framing members exceeding 0.2 percent of clear span when tested according to ASTM E 330.
 - 1) Test pressure: 150 percent of inward and outward wind-load design pressures.
 - 2) Duration: As required by design wind velocity; fastest one mile of wind for relevant exposure category.
 - e. Deflection of framing members:
 - 1) Deflection normal to wall plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed U240 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4-inch, whichever is less.
 - 2) Deflection parallel to glazing plane: Limited to U360 of clear span or 1/8-inch, whichever is smaller, but in no case by an amount which reduces

glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below them to less than 1/8-inch and clearance between members and operable units directly below them to less than 1/16-inch.

- B. Delegated design: Design aluminum-framed glazed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
 - 1. Thermal movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 2. Temperature change (range): 120 deg F, ambient; 180 deg F, material surfaces.
 - a. Test performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA501.5.
 - 1) High exterior ambient-air temperature: That which produces an exterior metal-surface temperature of 180 deg F.
 - 2) Low exterior ambient-air temperature: 0 deg F.
 - 3) Interior ambient-air temperature: 75 deg F (24 deg C).
 - 3. Energy Performance:
 - a. NFRC values at exterior non-curtain Walls:
 - 1) U value: 0.45
 - 2) SHGC: 0.24
- D. Load transfer: Framing members shall not transfer stresses, including those caused by thermal and structural movement, to glazing units.
- E. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at specified differential pressure across assembly in accordance with ASTM E283 at a minimum static air pressure difference of 6.24 lbf/square-foot.
- F. Condensation resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.
- G. Water penetration under static pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. -foot (300 Pa).
- H. Acoustical Performance Requirements:
 - 1. Sound Attenuation: STC of 32, minimum, from exterior to interior.
 - 2. Test Method: ASTM EgO, with calculation in accordance with ASTM E413.

- I. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- J. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glass and inner sheet of intill panel and heel bead of glazing compound.
- K. Story drift: Provide aluminum-framed systems that accommodate design displacement of adjacent stories indicated.
 - 1. Design displacement: As indicated on Drawings.
 - 2. Test performance: Meet criteria for passing, based on building occupancy type, when tested according to AAMA 501.4 at design displacement and 1.5 times design displacement.
- L. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
- M. Additional performance requirements for doors: Resistance to corner racking shall be tested by the "Dual Moment Load" test as follows.
 - 1. Test section shall consist of a standard top door corner assembly. Side rail section shall be 24 inches long; top rail section shall be 12 inches long.
 - 2. Anchor "top rail" positively to test bench so that corner protrudes 3-inches beyond the bench edge.
 - 3. Anchor a lever arm positively to "side rail" at a point 19 inches from the inside edge of "top rail" Attach weight support pad at a point 19 inches from inner edge of "side rail".
 - 4. Test section shall withstand a load of 170 lb. on the lever arm before reaching the point of a 1/18-inch gap at the stile/rail, joint or a 3-degree rotation in the stile. Further failure, defined as a rotation of the lever arm in excess of 45, shall not be reached before 270 lb.

2.5 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
 - 1. Framing members for exterior and interior applications need not be thermally broken.
 - 2. Glazing stops: Flush.
 - 3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
- B. Exterior Doors: Glazed aluminum.
 - 1. Thickness: 1-3/4 inches.
 - 2. Top Rail: 5 inches wide.
 - 3. Vertical Stiles: 5 inches wide.
 - 4. Bottom Rail: 12 inches wide.
 - 5. Glazing Stops: Square.
 - 6. Finish: Same as storefront.
 - 7. Basis of Design: 500 Tuffline by Kawneer.

- C. Interior Doors: Glazed aluminum.
 - 1. Thickness: 1-3/4 inches.
 - 2. Top Rail: 5 inches wide
 - 3. Vertical Stiles: 5 inches wide.
 - 4. Bottom Rail: 12 inches wide.
 - 5. Glazing Stops: Square.
 - 6. Finish: Same as storefront.
 - 7. Basis of Design: 500 Tuffline by Kawneer.

2.6 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221 M).
 - 1. 6063-T5 alloys. Provide a minimum nominal wall thickness of 1/8-inch for structural members and 1/16-inch for non-structural members.
 - a. Standard commercial tolerances listed in AA "Aluminum Standards and Data" apply to finished, fabricated and assembled materials, except
 - b. Provide stricter tolerances where required to assure proper functioning of glass and glazing materials.
- B. Sheet Aluminum: ASTM B209 (ASTM B209M).
 - 1. Provide a minimum nominal thickness of 3/16-inch. Standard commercial tolerances listed in AA "Aluminum Standards and Data" apply to finished, fabricated and assembled materials.
- C. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
- D. Fasteners: Non-magnetic stainless steel.
 - 1. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.125-inch thick, reinforce the interior with aluminum or non-magnetic stainless steel to receive screw threads, or provide standard non-corrosive pressed-in splined grommet nuts.
 - 2. Exposed fasteners: Except where unavoidable for application of hardware, do not use exposed fasteners. For the application of hardware, use fasteners that match the finish of member or hardware being fastened.
 - a. Provide Phillips flat-head machine screws for exposed fasteners.
 - 3. Welding electrodes: As recommended by AWS for the type of metal to be welded and the conditions of use.
- E. Exposed Flashings: 0.032 inch thick aluminum sheet; finish to match framing members.
- F. Concealed Flashings: 0.018 inch thick galvanized steel.
- G. Perimeter Sealant: Type SJ-3 specified in Section 07 90 05.
- H. Glass: As specified in Section 08 80 00.
- I. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

- J. Shims:
 - 1. At static connections use high impact polystyrene solid shims. Horseshoe shims are allowed at static connections only.
 - 2. At dynamic anchor conditions, use Nylatron isolating slip pads with hard round holes
- K. Weatherstripping:
 - 1. Compression weatherstripping: Manufacturer's standard replaceable compressible weatherstripping gaskets of molded neoprene complying with ASTM D 2000 or molded PVC complying with ASTM D 2287.
 - 2. Sliding weatherstripping: Manufacturer's standard replaceable weatherstripping of wool, polypropylene, or nylon woven pile, with nylon fabric or aluminum strip backing, complying with AAMA 701.
- L. Mullion closures: One of the following, or equal. Finish metal surfaces to match glazed assemblies mullions.
 - 1. When butting to glass: Michael Rizza Co., Inc, "Partition Closure," or equal, of the depth recommended by the manufacturer for the condition of use.
 - 2. When butting an aluminum mullion: Gordon Interior Specialties Div. "Mullion Mate," or equal.
- M. Foam insulation: Closed-cell polyurethane. Use in mullions and closure pieces that cannot be insulated during or after assembly.
- N. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.7 FINISHES

- A. Superior Performance Organic Coating System: Permaflour coating; AAMA 2605, Dry film Thickness 01.2 mil.
- B. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.8 HARDWARE

- A. Door Hardware: Storefront manufacturer's standard type to suit application.
 - 1. Exception: cylinder to be supplied under Section 08 71 00.
 - 2. Finish on Hand-Contacted Items: Polished chrome.
 - 3. Include for each door weatherstripping, sill sweep strip, threshold, pivots, pull handle, exit device, and closer.
- B. Weatherstripping: See Materials above.

2.9 FABRICATION

- A. Furnish shop drawings, inserts and similar items to other trades, at appropriate times as required for proper sequence of construction.

- B. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- C. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- D. Prepare components to receive anchor devices. Fabricate anchors.
- E. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- F. Arrange fasteners and attachments to conceal from view.
- G. Reinforce components internally for door hardware.
- H. Reinforce framing members for imposed loads.
- I. Removable members such as glass stops, fillers or closures shall be extruded, and securely engaged into adjacent components. Fabricate extrusions to eliminate edge projection, bowing, and misalignment at joints.
- J. Design and construct expansion joints so that they will be, and remain, permanently watertight, and will accommodate weather and building dynamics.
- K. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
 - 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.2 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Set thresholds in bed of mastic and secure.
- K. Install hardware using templates provided.
- L. Install glass in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.
- M. Install perimeter sealant in accordance with Section 07 92 05.
- N. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

- A. Maximum Variation from Plumb: 0.03 inches every 3 ft non-cumulative or 1/8 inches per 10 ft, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for independent testing and inspection requirements. Inspection will monitor quality of installation and glazing.
- B. Test installed storefront for water leakage in accordance with AAMA 501.2.

3.5 ADJUSTING

- A. Adjust operating hardware and sash for smooth operation.

3.6 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.

- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

3.7 PROTECTION

- A. Protect installed products from damage during subsequent construction.

END OF SECTION

SECTION 08 70 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Door hardware, including electric hardware.
2. Storefront and entrance door hardware.
3. Gate Hardware.
4. Power supplies for electric hardware.
5. Low energy door operators plus sensors and actuators.
6. Door position switches.
7. Point-to-point wiring diagrams for electric hardware.

B. Related Divisions:

1. Division 06 – door hardware installation
2. Division 07 – sealant at exterior thresholds
3. Division 08 – metal doors and frames, interior aluminum frames, wood doors, integrated security systems, and storefront systems.
4. Division 28 – security access systems

C. Specific Omissions: Hardware for the following is specified or indicated elsewhere.

1. Windows.
2. Cabinets, including open wall shelving and locks.
3. Signs.
4. Toilet accessories, including grab bars.
5. Installation.
6. Rough hardware.
7. Conduit, junction boxes & wiring.
8. Access doors and panels.

1.2 REFERENCES:

A. Use date of standard in effect as of Bid date.

1. American National Standards Institute – ANSI 156.18 – Materials and Finishes.
 - a) ANSI A156.18 Materials and Finishes
2. BHMA – Builders Hardware Manufacturers Association
3. DHI – Door and Hardware Institute
4. NFPA – National Fire Protection Association
 - a) NFPA 80 – Fire Doors and Windows
 - b) NFPA 105 – Smoke and Draft Control Door Assemblies
 - c) NFPA 252 – Fire Tests of Door Assemblies
5. UL – Underwriters Laboratories

- a) UL10C – Positive Pressure Fire Tests of Door Assemblies.
- b) UL 305 – Panic Hardware
- 6. WHI – Warnock Hersey Incorporated State of California Building Code
- 7. Local applicable codes
- 8. SDI – Steel Door Institute
- 9. WI – Woodwork Institute
- 10. AWI – Architectural Woodwork Institute
- 11. NAAMM – National Association of Architectural Metal Manufacturers

B. Abbreviations

- 1. Manufacturers: see table at 2.1.A of this section
- 2. Finishes: see 2.7 of this section.

1.3 SUBMITTALS & SUBSTITUTIONS

- A. SUBMITTALS:** Submit six copies of schedule per Section 01330. Only submittals printed one sided will be accepted and reviewed. Organize vertically formatted schedule into “Hardware Sets” with index of doors and headings, indicating complete designations of every item required for each door or opening. Minimum 10pt font size. Include following information:
- 1. Type, style, function, size, quantity and finish of hardware items.
 - 2. Use BHMA Finish codes per ANSI A156.18.
 - 3. Name, part number and manufacturer of each item.
 - 4. Fastenings and other pertinent information.
 - 5. Location of hardware set coordinated with floor plans and door schedule.
 - 6. Explanation of abbreviations, symbols, and codes contained in schedule.
 - 7. Mounting locations for hardware.
 - 8. Door and frame sizes, materials and degrees of swing.
 - 9. List of manufacturers used and their nearest representative with address and phone number.
 - 10. Catalog cuts.
 - 11. Point-to-point wiring diagrams.
 - 12. Manufacturer’s technical data and installation instructions for electronic hardware.
- B.** Bid and submit manufacturer’s updated/improved item if scheduled item is discontinued.
- C.** Deviations: Highlight, encircle or otherwise identify deviations from “Schedule of Finish Hardware” on submittal with notations clearly designating those portions as deviating from this section.
- D.** If discrepancy between drawings and scheduled material in this section, bid the more expensive of the two choices, note the discrepancy in the submittal and request direction from Architect for resolution.
- E.** Substitutions per Division 1. Include product data and indicate benefit to the Project. Furnish operating samples on request.
- F.** Items listed with no substitute manufacturers have been requested by Owner to meet existing standard.

- G. Furnish as-built/as-installed schedule with closeout documents, including keying schedule, riser and point-to-point wiring diagrams, manufacturers' installation, adjustment and maintenance information, and supplier's final inspection report.

1.4 QUALITY ASSURANCE:

A. Qualifications:

- 1. Hardware supplier: direct factory contract supplier who employs a certified architectural hardware consultant (AHC), available at reasonable times during course of work for project hardware consultation to Owner, Architect and Contractor.
 - a) Responsible for detailing, scheduling and ordering of finish hardware. Detailing implies that the submitted schedule of hardware is correct and complete for the intended function and performance of the openings.

- B. Hardware: Free of defects, blemishes and excessive play. Obtain each kind of hardware (latch and locksets, exit devices, hinges and closers) from one manufacturer.
- C. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.
- D. Fire-Rated Openings: NFPA 80 compliant. Hardware UL10C / UBC Standard 7-2 (positive pressure) compliant for given type/size opening and degree of label. Provide proper latching hardware, non-flaming door closers, approved-bearing hinges, and resilient seals. Coordinate with wood door section for required intumescent seals. Furnish openings complete.
- E. Furnish hardware items required to complete the work in accordance with specified performance level and design intent, complying with manufacturers' instructions and code requirements.

1.5 DELIVERY, STORAGE AND HANDLING:

- A. Delivery: coordinate delivery to appropriate locations (shop or field).
 - 1. Permanent keys and cores: secured delivery direct to Owner's representative.
- B. Acceptance at Site: Items individually packaged in manufacturers' original containers, complete with proper fasteners and related pieces. Clearly mark packages to indicate contents, locations in hardware schedule and door numbers.
- C. Storage: Provide securely locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, dust, excessive heat and cold, etc.

1.6 PROJECT CONDITIONS AND COORDINATION:

- A. Where exact types of hardware specified are not adaptable to finished shape or size of members requiring hardware, provide suitable types having as nearly as practical the same operation and quality as type specified, subject to Architect's approval.

- B. **Coordination:** Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents. Furnish related trades with the following information:
1. Location of embedded and attached items to concrete.
 2. Location of wall-mounted hardware, including wall stops.
 3. Location of finish floor materials and floor-mounted hardware.
 4. At masonry construction, coordinate with the anchoring and hollow metal supplier prior to frame installation by placing a strip of insulation, wood, or foam, on the back of the hollow metal frame behind the rabbet section for continuous hinges, as well as at rim panic hardware strike locations, silencers, coordinators, and door closer arm locations. When the frame is grouted in place, the backing will allow drilling and tapping without dulling or breaking the installer's bits.
 5. Locations for conduit and raceways as needed for electrical, electronic and electro-pneumatic hardware items. Fire/life-safety system interfacing. Point-to-point wiring diagrams plus riser diagrams to related trades.
 6. Coordinate: flush top rails of doors at out swinging exteriors, and throughout where adhesive-mounted seals occur.
 7. Manufacturers' templates to door and frame fabricators.
- C. Check Shop Drawings for doors and entrances to confirm that adequate provisions will be made for proper hardware installation.
- D. **Environmental considerations:** segregate unused recyclable paper and paper product packaging, uninstalled metals, and plastics, and have these sent to a recycling center.

1.7 WARRANTY:

- A. Part of respective manufacturers' regular terms of sale. Provide manufacturers' written warranties:
- | | |
|-------------------|---|
| 1. Locksets: | Three years |
| 2. Exit Devices: | Three years mechanical
One year electrical |
| 3. Closers: | Ten years mechanical
Two years electrical |
| 4. Other Hardware | Two years |

1.8 COMMISSIONING:

- A. Conduct these tests prior to request for certificate of substantial completion:
1. With installer present, test door hardware operation with climate control system and stairwell pressurization system both at rest and while in full operation.
 2. With installer, access control contractor and electrical contractor present, test electrical, electronic and electro-pneumatic hardware systems for satisfactory operation.

3. With installer and electrical contractor present, test hardware interfaced with fire/life-safety system for proper operation and release.

1.9 REGULATORY REQUIREMENTS:

- A. Locate latching hardware centered between 34 inches to 44 inches above the finished floor, per California Building Code, Section 1008.1.9.2 and 1133B.2.5.2.
 1. Locate panic hardware centered between 36 inches to 44 inches above the finished floor.
- B. Handles, pull, latches, locks, other operating devices: readily openable from egress side without tight grasping, tight pinching, or twisting of the wrist to operate. California Building Code 1133B.2.5.2.
- C. Adjust doors to open with not more than 5.0-pounds pressure to open at exterior doors and 5.0-pounds at interior doors. As allowed per California Building Code, Section 1133B.2.5 and 1008.1.3, DSA authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15-pounds.
 1. Door latch shall release when subjected to a 5-pound force.
 2. Once set in motion, door shall swing to a full-open position when subjected to a 5-pound force.
- D. Adjust door closer sweep periods so that from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door, per California Building Code Section 1133B.2.5.1.
- E. Smooth surfaces at bottom 10 inches of push sides of doors, facilitating push-open with wheelchair footrests, per California Building Code Section 1133B.2.6.
- F. Door opening clear width no less than 32 inches, measured from face of frame stop, or edge of inactive leaf of pair of doors, to door face with door opened to 90 degrees. Hardware projection not a factor in clear width if located above 30 inches and the hardware projects no more than 4 inches. California Building Code Section 1133B.2.2, 1133B.2.3, and 1008.1.1.
 1. Exception: doors not requiring full passage through the opening, that is, to spaces less than 24 inches in depth, may have the clear opening width reduced to 20 inches. Example: shallow closets.
- G. Door opening clear height no less than 80 inches measured from top of sill to bottom of frame header stop. Projections into clear opening height not to exceed 4 inches. California Building Code Section 1133B.2.2 and 1008.1.1.
- H. Thresholds: floor or landing no more than 0.50 inches below the top of the threshold of the doorway. Change in level between 0.25 inches and 0.50 inches: beveled to slope no greater than 1:2 (50 percent slope). California Building Code Section 1133B.2.4.1.
- I. Floor stops: Do not locate in path of travel. Locate no more than 4 inches from walls, per DSA Policy #99-08 (Access).
- J. Pairs of doors: limit swing of inactive leaf to 90 degrees to protect persons reading wall-mounted tactile signage.
- K. Meet California Building Code Sections 1133B.2.1, 1133B.2.5.2 and 1008.1.9.

- L. Hardware (including panic hardware) shall not be provided with “night latch” (NL) function for any accessible doors or gates unless the following conditions are met per DSA interpretation 10-08 DSA/AC (external), revised 4/28/09. Such conditions must be clearly demonstrated and indicated in specifications;
 - 1. Such hardware has a ‘dogging feature’
 - 2. It is dogged during the time facility is open.
 - 3. Such dogging operation is performed only by employees as their job function (non-public use).
- M. Exit Devices:
 - 1. Panic hardware shall comply with CBC Section 1008.1.10 (consider that if the device is mounted lower than 36 inches AFF, the clear opening may be restricted to less than the 32 inches required clear opening). Panic bar shall be mounted 36 inches to 44 inches above finished floor surface.
 - 2. The unlatching force shall not exceed 15-pounds applied in the direction of travel. California Building Code 1008.1.10.1.4, and California Referenced Standards Code 12-10-302.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

- A. Listed acceptable alternate manufacturers: these will be considered; submit for review products with equivalent function and features of scheduled products.

ITEM:	MANUFACTURER:	ACCEPTABLE ALTERNATE:
Hinges	(IVE) Ives	Bommer
Continuous Hinges	(IVE) Ives	Select
Key System	(SCH) Schlage	District standard
Mechanical Locks	(SCH) Schlage	District standard
Electronic Locks	(SCE) Schlage Electronics	District standard
Exit Devices	(VON) Von Duprin	District standard
Closers	(LCN) LCN	District standard
Auto Flush Bolts	(IVE) Ives	DCI
Coordinators	(IVE) Ives	DCI
Silencers	(IVE) Ives	Rockwood, Trimco
Push & Pull Plates	(IVE) Ives	Rockwood, Trimco
Kickplates	(IVE) Ives	Rockwood, Trimco
Stops & Holders	(IVE) Ives	Rockwood, Trimco
Overhead Stops	(GLY) Glynn-Johnson	ABH
Thresholds	(NGP) NGP	Zero, Reese
Seals & Bottoms	(NGP) NGP	Zero, Reese

2.2 HINGING METHODS:

- A. Drawings typically depict doors at 90 degrees, doors will actually swing to maximum allowable. Use wide-throw conventional or continuous hinges as needed up to 8 inches in width to allow door to stand parallel to wall for true 180-degree opening. Advise architect if 8-inch width is insufficient.

- B. Conform to manufacturer's published hinge selection standard for door dimensions, weight and frequency, and to hinge selection as scheduled. Where manufacturer's standard exceeds the scheduled product, furnish the heavier of the two choices, notify Architect of deviation from scheduled hardware.
- C. Conventional Hinges: Steel or stainless steel pins and concealed bearings. Hinge open widths minimum, but of sufficient throw to permit maximum door swing.
 - 1. Outswinging exterior doors: non-ferrous with non-removable (NRP) pins and security studs.
 - 2. Non-ferrous material exteriors and at doors subject to corrosive atmospheric conditions.
- D. Continuous Hinges:
 - 1. Geared-type aluminum.
 - a) Use wide-throw units where needed for maximum degree of swing, advise architect if commonly available hinges are insufficient.
 - b) If units are used at storefront openings, color-coordinate hinge finish with storefront color. Custom anodizing and custom powdercoat finishes subject to Architect approval.
 - 2. Pinned steel/stainless steel type: continuous stainless steel, 0.25-inch diameter stainless-steel hinge pin.
 - a) Use engineered application-specific wide-throw units as needed to provide maximum swing degree of swing, advise architect if required width exceeds 8 inches.

2.3 LOCKSETS, LATCHSETS, DEADBOLTS:

- A. Mortise Locksets and Latchsets: as scheduled.
 - 1. Chassis: cold-rolled steel, handing field-changeable without disassembly.
 - 2. Universal lock case – 10 functions in one case.
 - 3. Floating mounting tabs automatically adjusts to fit a beveled door edge.
 - 4. Latchbolts: 0.75 inch throw stainless steel anti-friction type.
 - 5. Lever Trim: through-bolted, accessible design, cast lever or solid extruded bar type levers as scheduled. Filled hollow tube design unacceptable.
 - a) Spindles: security design independent breakaway. Breakage of outside lever does not allow access to inside lever's hubworks to gain wrongful entry.
 - b) Inside lever applied by screwless shank mounting – no exposed trim mount screws.
 - c) Levers rotate up or down for ease of use.
 - 6. Furnish solid cylinder collars with wave springs. Wall of collar to cover rim of mortise cylinder.
 - 7. Thumbturns: accessible design not requiring pinching or twisting motions to operate.
 - 8. Electric operation: Manufacturer-installed continuous duty solenoid.

9. Strikes: 16 gage curved steel, bronze or brass with 1 inch deep box construction, lips of sufficient length to clear trim and protect clothing.
10. Scheduled Lock Series and Design: Schlage L series, 03A and 03N design where specified..
11. Certifications:
 - a) ANSI A156.13, 1994, Grade 1 Operational, Grade 1 Security.
 - b) ANSI/ASTM F476-84 Grade 31 UL Listed.
12. Accepted substitutions: None.

2.4 EXIT DEVICES / PANIC HARDWARE

A. General features:

1. Independent lab-tested 1,000,000 cycles.
2. Push-through push-pad design. No exposed push-pad fasteners, no exposed cavities when operated. Return stroke fluid dampeners and rubber bottoming dampeners, plus anti-rattle devices.
3. Deadlocking latchbolts, 0.75 inch projection.
4. End caps: impact-resistant, flush-mounted. No raised edges or lips to catch carts or other equipment.
5. No exposed screws to show through glass doors.
6. Non-handed basic device design with center case interchangeable with all functions, no extra parts required to effect change of function.
7. Releasable in normal operation with 15-pound maximum operating force per UBC Standard 10-4, and with 32-pound maximum pressure under 250-pound load to the door.
8. Exterior doors scheduled with XP-series devices: Static load force resistance of at least 2000 pounds.
9. Comply with CBC Section 1008.1.10.

B. Specific features:

1. Non-Fire Rated Devices: cylinder dogging.
2. Lever Trim: breakaway type, forged brass or bronze escutcheon min. 0.130 inch thickness, compression spring drive, match lockset lever design.
3. Fire-Labeled Devices: UL label indicating "Fire Exit Hardware". Vertical rod devices less bottom rod (LBR) unless otherwise scheduled.
4. Electrically Operated Devices: Single manufacturer source for electric latch retraction devices, electrically controlled trim, power transfers, power supplies, monitoring switches and controls.
5. Removable Mullions: Removable with single turn of building key. Securely reinstalled without need for key. Furnish storage brackets for securely stowing the mullion away from the door when removed.
6. Accepted substitutions: None.

2.5 CLOSERS

C. Surface Closers:

1. Full rack-and-pinion type cylinder with removable non-ferrous cover and cast iron body. Double heat-treated pinion shaft, single piece forged piston, chrome-silicon steel spring.
2. ISO 2000 certified. Units stamped with date-of-manufacture code.
3. Independent lab-tested 10,000,000 cycles.
4. Non-sized, non-handed, and adjustable. Place closer inside building, stairs, and rooms.
5. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.
6. Adjustable to open with not more than 5.0-pounds pressure to open at exterior doors and 5.0-pounds at interior doors. As allowed per California Building Code, Section 1133B.2.5 and 1008.1.3, DSA authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15-pounds.
7. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
8. Extra-duty arms (EDA) at exterior doors scheduled with parallel arm units.
9. Exterior door closers: tested to 100 hours of ASTM B117 salt spray test, furnish data on request.
10. Exterior doors: seasonal adjustments not required for temperatures from 120 degrees F to -30 degrees F, furnish checking fluid data on request.
11. Non-flaming fluid, will not fuel door or floor covering fires.
12. Pressure Relief Valves (PRV) not permitted.
13. Accepted substitutions: None.

D. LCN Senior Swing:

1. Comply with ANSI/BHMA 156.19: Electric power-open and close operation. Modular construction. Finished metal cover. Field-adjustable opening force, opening speed, time-open, closing and latching speeds. Door reopens and timing cycle restores if system re-actuated during closing cycle. Breakaway clutch protection from forced closing. Door, frame, motor and drive train protected by attenuated initiation of opening cycle.
2. Self-contained low-voltage power supply, terminal strip and sequencing for incorporation of electric hardware with system operation.
3. Actuators: as scheduled
 - a) Vertical bar type: minimum 2 inches wide by 30 inches in height. Locate bar with bottom 5 inches maximum above finish floor, and top 35 inches minimum above finish floor.
 - b) Actuators of either type: display International Symbol of Accessibility pictogram.

2.6 OTHER HARDWARE

- A. Automatic Flush Bolts: Low operating force design.
- B. Overhead Stops: Non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.

- C. Kick Plates: Four beveled edges, .050 inches minimum thickness, height and width as scheduled. Sheet-metal screws of bronze or stainless steel to match other hardware.
- D. Door Stops: Provide stops to protect walls, casework or other hardware.
 - 1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where floor type cannot be used, provide wall type. If neither can be used, provide overhead type.
 - 2. Locate overhead stops for maximum possible opening. Consult with Owner for furniture locations. Minimum: 90deg stop / 95deg deadstop. Note degree of opening in submittal.
- E. Seals: Four-fingered type at head & jambs. Inelastic, rigid back, not subject to stretching. Self-compensating for warp, thermal bow, door settling, and out-of-plumb. Adhesive warranted for life of installation.
 - 1. Proposed substitutions: submit for approval.
 - 2. Three-fingered type at hinge jambs of doors fitted with continuous hinges where jamb leaf of hinge is fastened to the frame reveal.
- F. Sound-reducing adjustable seals: coordinate lockset backsets, rim exit device strikes, and parallel arm closers. Fabricate 7ga "Z"-brackets as bridging pieces to facilitate installation. Brackets: mild carbon steel, or stainless steel.
- G. Automatic door bottoms: low operating force units. Doors with automatic door bottoms plus head and jamb seals cannot require more than two pounds operating force to open when closer is disconnected.
- H. Thresholds: As scheduled and per details. Comply with CBC Section 1133B.2.4.1. Substitute products: certify that the products equal or exceed specified material's thickness. Proposed substitutions: submit for approval.
 - 1. Saddle thresholds: 0.125 inches minimum thickness.
 - 2. Exteriors: Seal perimeter to exclude water and vermin. Use sealant complying with requirements in Division 7 "Thermal and Moisture Protection". Minimum 0.25 inch diameter fasteners and lead expansion shield anchors, or Red-Head #SFS-1420 (or approved equivalent) Flat Head Sleeve Anchors (SS/FHSL).
 - 3. Fire-rated openings, 90-minutes or less duration: use thresholds to interrupt floor covering material under the door where that material has a critical radiant flux value less than 0.22 watts per square centimeter, per NFPA 253. Use threshold unit as scheduled. If none scheduled, request direction from Architect.
 - a) City of Los Angeles: regardless of critical radiant flux values of organic-material floor coverings, furnish metal, concrete, or stone thresholds at fire-rated openings.
 - 4. Fire-rated openings, 3-hour duration: Thresholds, where scheduled, to extend full jamb depth.
 - 5. Acoustic openings: Set units in full bed of Division-7-compliant, leave no air space between threshold and substrate.
 - 6. Plastic plugs with wood or sheet metal screws are not an acceptable substitute for specified fastening methods.

7. Fasteners: Generally, exposed screws to be Phillips or Robertson drive. Pinned TORX drive at high security areas. Flat head sleeve anchors (FHSL) may be slotted drive. Sheet metal and wood screws: full-thread. Sleeve nuts: full length to prevent door compression.
 - I. Through-bolts: Do not use. Coordinate with wood doors; ensure provision of proper blocking to support wood screws for mounting panic hardware and door closers. Coordinate with metal doors and frames; ensure provision of proper reinforcement to support machine screws for mounting panic hardware and door closers.
 1. Exception: surface-mounted overhead stops, holders, and friction stays.
 - J. Silencers: Interior hollow metal frames, 3 for single doors, 4 for pairs of doors. Leave no unfilled/uncovered pre-punched silencer holes. Intent: door bears against silencers, seals make minimal contact with minimal compression – only enough to effect a seal.
- 2.7 FINISH:
- A. Generally: BHMA 626 Satin Chromium.
 1. Areas using BHMA 626: furnish push-plates, pulls and protection plates of BHMA 630, Satin Stainless Steel, unless otherwise scheduled.
 - B. Door closers: factory powder coated to match other hardware, unless otherwise noted.
- 2.8 KEYING REQUIREMENTS:
- A. Key System: Schlage Everest *D-135* high-security utility-patented keyway, interchangeable core throughout. Key blanks available only from factory-direct sources, not available from after-market keyblank manufacturers. For estimate use factory GMK charge. Initiate and conduct meeting(s) with District and I-R Security Technologies representatives to determine system keyway(s), keybow styles, structure, stamping, degree of physical security and degree of geographic exclusivity. Furnish Owner's written approval of the system; do not order keys or cylinders without written confirmation of actual requirements from the District. Verify if District/Contractor will install permanent cylinders/cores.
 1. Existing factory-registered master key system.
 - ~~2. ***Primus Level 9 (verify with District)***~~
 3. Construction keying: furnish temporary keyed-alike cores. Remove at substantial completion and install permanent cylinders/cores in Owner's presence. Demonstrate that construction key no longer operates.
 4. Temporary cylinders/cores remain supplier's property.
 5. Furnish 10 construction keys.
 6. Furnish 2 construction control keys.
 7. Key Cylinders: furnish 6-pin solid brass construction.
 8. *Provide 100 blank keys.*
 9. *Provide permanent cylinders by substantial completion.*
 - B. Cylinders/cores: keyed at factory of lock manufacturer where permanent records are maintained. Locksets and cylinders same manufacturer.
 - C. Permanent keys: use secured shipment direct from point of origination to Owner.

1. For estimate: 3 keys per change combination, ~~5 master keys per group~~, 5 grand-master keys, 3 control keys.
 2. For estimate: VKC stamping plus "DO NOT DUPLICATE".
- D. Biting List: use secured shipment direct from point of origination to Owner at completion.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS:

- A. Can read and understand manufacturers' templates, suppliers' hardware schedule and printed installation instructions. Available to meet with manufacturers' representatives and related trades to discuss installation of hardware.

3.2 PREPARATION:

- A. Ensure that walls and frames are square and plumb before hardware installation. Make corrections before commencing hardware installation. Installation denotes acceptance of wall/frame condition.
- A. Locate hardware per SDI-100 and applicable building, fire, life-safety, accessibility, and security codes.
1. Notify Architect of code conflicts before ordering material.
 1. Locate latching hardware centered between 34 inches to 44 inches above the finished floor, per California Building Code, Section 1008.1.9.2 and 1133B.2.5.2.
 2. Locate panic hardware centered between 36 inches to 44 inches above the finished floor.
- B. Overhead stops: before installing, determine proposed locations of furniture items, fixtures, and other items to be protected by the overhead stop's action.

3.3 INSTALLATION

- A. Install hardware per manufacturer's instructions and recommendations. Do not install surface-mounted items until finishes have been completed on substrate. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate for proper installation and operation. Remove and reinstall or replace work deemed defective by Architect.
1. Gaskets: install jamb-applied gaskets before closers, overhead stops, rim strikes, etc; fasten hardware over and through these seals. Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps.
 2. When hardware is to be attached to existing metal surface and insufficient reinforcement exists, use RivNuts, NutSerts or similar anchoring device for screws.
 3. Use manufacturers' fasteners furnished with hardware items, or submit Request for Substitution with Architect.
 4. Replace fasteners damaged by power-driven tools.

- B. Locate floor stops no more than 4 inches from walls and not within paths of travel. See paragraph 2.2 regarding hinge widths, door should be well clear of point of wall reveal. Point of door contact no closer to the hinge edge than half the door width. Where situation is questionable or difficult, contact Architect for direction.
- C. Locate overhead stops for minimum 90 degrees at rest and for maximum allowable degree of swing.
- D. Drill pilot holes for fasteners in wood doors and/or frames.

3.4. ADJUSTING

- A. Adjust and check for proper operation and function. Replace units, which cannot be adjusted to operate freely and smoothly.
 - 1. Hardware damaged by improper installation or adjustment methods: repair or replace to Owner's satisfaction.
 - 2. Adjust doors to fully latch with no more than 1 pound of pressure.
 - 3. Adjust delayed-action closers on fire-rated doors to fully close from fully-opened position in no more than 10 seconds.
 - 4. Adjust door closers per 1.9 this section.
- B. Inspection of fire door assemblies and means-of-egress panic-hardware doors: Hire an independent third-party inspection service to prepare a report listing these doors, and include a statement that there are zero deficiencies with the fire-rated assemblies and the openings with panic hardware.]
- C. Fire-rated doors:
 - 1. Wood doors: adjust to 0.125 inches clearance at heads, jambs, and meeting stiles.
 - 2. Steel doors: adjust to 0.063 inches minimum to 0.188 inches maximum clearance at heads, jambs, and meeting stiles.
 - 3. Adjust wood and steel doors to 0.75 inches maximum clearance (undercut) above threshold or finish floor material under door.
- D. Final inspection: Installer to provide letter to Owner that upon completion installer has visited the Project and has accomplished the following:
 - 1. Has re-adjusted hardware.
 - 2. Has evaluated maintenance procedures and recommend changes or additions, and instructed Owner's personnel.
 - 3. Has identified items that have deteriorated or failed.
 - 4. Has submitted written report identifying problems.
- E. Door Hardware Warranty Requirement: Contractor to adjust the door hardware prior to punchlist and again before NOC and again at the 11 month warranty review.

3.5 DEMONSTRATION:

- A. Demonstrate mechanical hardware and electrical, electronic and pneumatic hardware systems, including adjustment and maintenance procedures.

3.6 PROTECTION/CLEANING:

- A. Cover installed hardware, protect from paint, cleaning agents, weathering, carts/barrows, etc. Remove covering materials and clean hardware just prior to substantial completion.
- B. Clean adjacent wall, frame and door surfaces soiled from installation / reinstallation process.

3.7 SCHEDULE OF FINISH HARDWARE

- A. See door schedule in drawings for hardware set assignments.

HARDWARE SET NO. 01

PROVIDE EACH PR DOOR(S) WITH THE FOLLOWING:

Qty	Description	Catalog Number	Finish	Mfr

END OF SECTION

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SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Glass.
- B. Glazing compounds and accessories.

1.2 RELATED SECTIONS

- A. Section 08 41 23, Fire Rated Aluminum Framed Interior Storefronts.
- B. Section 08 43 13, Aluminum Frames Storefronts
- C. Section 08 11 13, Hollow Metal Door and Frames
- D. Energy calculations or prescriptive compliance documents.

1.3 ABBREVIATIONS AND ACRONYMS

- A. AAMA American Architectural Manufacturers Association
- B. ANSI American National Standards Institute
- C. ASTM Formerly the American Society for Testing and Materials
- D. CPSC Consumer Products Safety Commission
- E. FT Fully Tempered
- F. GANA Glass Association of North America
- G. HS Heat-strengthened
- H. ICC International Code Council
- I. IGCC Insulating Glass Certification Council
- J. IGMA Insulating Glass Manufacturers Alliance
- K. LBNL Lawrence Berkeley National Laboratories

- L. LEED Leadership in Energy & Environmental Design
- M. Low-E Low emissivity
- N. LSG Light to Solar Gain
- O. NFRC National Fenestration Rating Council
- P. SHGC Solar Heat Gain Coefficient
- Q. SC Shading Coefficient
- R. USGBC The U.S. Green Building Council
- S. VLT Visible Light Transmittance

1.4 DEFINITIONS

- A. *Deterioration of Coated Glass*: Defects developing from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking and other indications of deterioration in metallic coating.
- B. *Deterioration of Insulating Glass*: Failure of the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture or film on interior surfaces of glass.
- C. *Deterioration of Laminated Glass*: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delaminating material obstructing vision through glass and blemishes exceeding those allowed by referenced laminated glass standards.
- D. *Interspace or Airspace*: The space between lites of any insulating glass unit that contains dehydrated air or a specified gas.
- E. *Manufacturer*: A firm that produces primary glass or fabricated glass products as defined in referenced glazing publications.
- F. Performance Requirements
 - 1. *Energy Characteristics*: Certified U-Factor and SHGC of completed glazed assemblies shall conform to those required in the energy calculations or prescriptive energy compliance documents included in the Contract Documents.

1.5 ADMINISTRATIVE REQUIREMENTS

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

1.6 SUBMITTALS

- A. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- B. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- C. Samples: Submit two samples 12 by 12 inch in size of glass units.
- D. Test and Evaluation Reports: Glazing contractor shall obtain compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealant as well as other glazing materials including insulating units.
- E. Manufacturer Reports: Submit Glass Fabricator's Shop Drawing Review indicating compliance with glazing standards established by the Glass Association of North America (GANA). Submittal to include thermal stress and structural load analysis of the proposed glass types, configuration and sizes.
- F. Certificates: Certify that products meet or exceed specified requirements.
- G. Sustainable Design Submittals: Provide the following information
 - 1. Local/Regional Materials
 - 2. Recycled Materials
 - a. Float glass manufacturing feedstock materials are scrutinized as part of a quality process given the sensitive nature of glass production. It is common for manufacturers to produce scrap glass, called cullet, which is stockpiled and then reprocessed and reutilized into the manufacturing process. The range of cullet typically comprises between 10%- 20% of the final manufactured glass product, this should be verified with the manufacturer. Because cullet is generated at the manufacturing site, the chemical make-up of the cullet is known, and it can be sorted and stockpiled appropriately prior to reutilization as feedstock. If cullet is being claimed toward recycled content, it should be determined that the cullet is being fed from the end of a production line (as waste in the production process) back into the beginning of the same line. This should be noted in the special environmental requirements product form.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.

- B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience.
- C. Safety glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI 297.1.
 - 1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction in accordance with ASTM C 1048 and CBC 2406.2.
- D. Insulating glass certification program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following inspecting and testing agencies:
 - 1. Insulating Glass Certification Council.
 - 2. Associated Laboratories, Inc.
 - 3. National Accreditation and Management Institute.
- E. Mock-ups: Before glazing, build mockups for each glass product indicated in section 2.5 Product Schedule to verify selections and to demonstrate aesthetic effects and qualities of materials and execution.
 - 1. Construction: Build mockups with glass and glazing systems specified for the project, including typical lite size, framing systems and glazing methods.
 - 2. Scheduling: Notify architect seven days in advance of dates and times when mockups will be available for viewing.
 - 3. Quality Assurance: Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work. Accepted mockups may become part of the completed work if undisturbed at the time of substantial completion.

1.8 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.9 WARRANTY

- A. See Section 01 77 00 - Closeout Procedures, for additional warranty requirements.
- B. Sealed Insulating Glass Units: Provide a five (5) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.
- C. Laminated Glass: Provide a five (5) year warranty to include coverage for delamination, including replacement of failed units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Non-Fire-Rated Glass Manufacturers: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
 - 1. PPG Glass (Basis of Design).
 - 2. Guardian.
 - 3. Pilkington.
 - 4. Visteon.
 - 5. Or equal.
- B. Non-Fire-Rated Glazing Fabricators: Subject to compliance with requirements, provide either the named fabricator or an equal fabricator by one of the other fabricators specified.
 - 1. Oldcastle Glass. (Basis of Design)
 - 2. Viracon.
 - 3. Guardian.
 - 4. Or equal.

2.2 GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.
- B. Heat-Treated Float Glass (Safety Glass): ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.
 - 1. Provide Kind FT (fully tempered) float glass at interior pane of insulated glass unit for all exterior storefronts, doors and aluminum windows and in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 - 2. For uncoated glass, comply with requirements for Condition A.
 - 3. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
- C. Sputter-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide or -nitride coating deposited by vacuum deposition process after manufacture and heat treatment (if any), and complying with other requirements specified.
- D. Laminated Glass: 3/8" thickness. Place in interior hollow metal windows, ASTM C 1172, and complying with other requirements specified and with the following:
 - 1. Interlayer: Polyvinyl butyral of thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.
 - a. For polyvinyl butyral interlayers, laminate lites in autoclave with heat plus pressure.

- b. For cured-resin interlayers, laminate lites with laminated-glass manufacturer's standard cast-in-place and cured-transparent-resin interlayer.
 2. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets.
- E. Ceramic-Coated Vision Glass: Heat treated float glass with ceramic enamel applied by silk-screened process and complying with ASTM C 1048, Condition C (other coated glass), Type I (transparent flat glass), Quality-Q3, Specification No. 95-1-31 in GANA Tempering Division's "Engineering Standards Manual," and other requirements specified. Place at No. 3 surface of insulating unit in windows designated in window schedule. Pattern to be selected by architect from manufacturers standard patterns.
- F. Tinted Insulating-Glass Units: Insulated glass units for all exterior storefronts, doors and aluminum windows: Double pane, low-e with glass to elastomer edge seal. Outer pane of tinted glass, inner pane of clear glass or ceramic-coated vision glass. Place reflective coating on No.2 surface within the unit.
 1. Product: Solarban 60 (2) Gray + Clear Glass Insulating glass Unit by PPG.
 2. Visible Transmittance: 35%.
 3. Visible Light Reflectance: 6% (exterior) and 10% (interior)
 4. U-Value:
 - a. Winter Night time: 0.29.
 - b. Summer Day time: 0.28
 5. Shading Coefficient: 0.29.
 6. Solar Heat Gain Coefficient: 0.25
 7. Light to Solar Gain (LSG): 1.40
- G. Fire-Protection-Rated Safety Glazing.
 1. Application: Vision lites in fire-resistance-rated doors, sidelights and fire rated windows
 2. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies.
 3. Film-Faced Ceramic Glazing: Clear, ceramic flat glass; 3/16-inch nominal thickness; faced on one surface with a clear glazing film; complying with testing requirements in 16 CFR 1201 for Category II materials. Subject to compliance with requirements, provide one of the following:
 - a. Nippon Electric Glass Co., Ltd. (distributed by Technical Glass Products); Standard FireLite NT
 - b. Safti First; SuperLite
 - c. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.
- H. Sealed Insulating Glass Units: ASTM E 774, Class A.
 1. Nominal Thickness: 1 inch
 2. Glass - Vision Units: Two lites, one fire-rated and one -way mirror glass as scheduled:
 - a. Exterior Lite: One way transparent mirror clear glass
 - b. Interior Lite: Clear FireLite NT with premium surface finish, FireLite Plus® with Premium finish.

3. Air Space Width: Nominal 1/2 inch measured perpendicularly from surfaces of glass lites at unit's edge.
4. Sealing System: Dual seal, 10 year limited warranty.
5. Spacer Specifications: Manufacturer's standard stainless steel.
 - a. Desiccant: Manufacturer's standard desiccant.
 - B. Corner Construction: Manufacturer's standard corner construction.

I. One-way Vision Glass

1. ***“Mirropane” manufactured by Libby-Owens-Ford Co.; 1/4” thick glazing quality, tempered clear glass with scratch-proof evaporated chromium alloy reflective coating one side, PPG Industries, Inc., or equal.***

2.3 EXTERIOR GLAZING ASSEMBLIES

- A. Structural Design Criteria: Select type and thickness to withstand dead loads and wind loads acting normal to plane of glass at design pressures calculated in accordance with California Building code.
 1. Use the procedure specified in ASTM E1300 to determine glass type and thickness.
 2. Limit glass deflection to 1/200 or flexure limit of glass, whichever is less, with full recovery of glazing materials.
 3. Thicknesses listed are minimum.
- B. Air and Vapor Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier:
 1. In conjunction with vapor retarder and joint sealer materials described in other sections.
 2. To utilize the inner pane of multiple pane sealed units for the continuity of the air barrier and vapor retarder seal.
 3. To maintain a continuous air barrier and vapor retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.

2.4 GLAZING COMPOUNDS

- A. Manufacturers:
 1. Bostik Inc: www.bostik-us.com.
 2. Mumentive Performance Materials, Inc (formerly GE Silicones): www.mumentive.com.
 3. Pecora Corporation: www.pecora.com.
 4. Substitutions: Refer to Section 01 60 00 - Product Requirements.
- B. Glazing Putty (Type GP-1): Polymer modified latex recommended by manufacturer for outdoor use, knife grade consistency; grey color.
- C. Silicone Sealant (Type SJ-3): Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C 920, Type S, Grade NS, Class 25, Uses M, A, and G; cured Shore A hardness of 15 to 25; color to match window frame color.

2.5 GLAZING ACCESSORIES

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness, ASTM C864 Option I. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness, ASTM C 864 Option I. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- C. Glazing Tape: Preformed butyl compound with integral resilient tube spacing device; 10 to 15 Shore A durometer hardness; coiled on release paper; size; black color.
 - 1. Manufacturers:
 - a. Pecora Corporation: www.pecora.com.
 - b. Tremco Global Sealants: www.tremcosealants.com.
 - c. Substitutions: Refer to Section 01 60 00 - Product Requirements.
- D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option I; color to match window frame color.
- E. Glazing Clips: Manufacturer's standard type.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Prime surfaces scheduled to receive sealant.
- C. Install sealants in accordance with ASTM C1193 and FGMA Sealant Manual.
- D. Install sealant in accordance with manufacturer's instructions.

3.3 INSTALLATION - EXTERIOR DRY METHOD (TAPE AND GASKET SPLINE GLAZING)

- A. Cut glazing tape to length; install on glazing pane. Seal corners by butting tape and sealing junctions with butyl sealant.

- B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
- D. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
- E. Trim protruding tape edge.

3.4 INSTALLATION – EXTERIOR WET & DRY METHOD (PREFORMED TAPE AND SEALANT)

- A. Cut glazing tape to length and set against permanent stops, 3/16 inch below sight line. Seal corners by butting tape and dabbing with butyl sealant.
- B. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.
- C. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
- D. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.
- E. Install removable stops, with spacer strips inserted between glazing and applied stops, 1/4 inch below sight line. Place glazing tape on glazing pane or unit with tape flush with sight line.
- F. Fill gap between glazing and stop with SJ-3 type sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch below sight line.
- G. Apply cap bead of SJ-3 type sealant along void between the stop and the glazing, to uniform line. flush with sight line. Tool or wipe sealant surface smooth.

3.5 INSTALLATION - EXTERIOR WET METHOD (SEALANT AND SEALANT)

- A. Place setting blocks at 1/4 points and install glazing pane or unit.
- B. Install removable stops with glazing centered in space by inserting spacer shims both sides at 24 inch intervals, 1/4 inch below sight line.
- C. Fill gaps between glazing and stops with SJ-3 type sealant to depth of bite on glazing, but not more than 3/8 inch below sight line to ensure full contact with glazing and continue the air and vapor seal.
- D. Apply sealant to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.6 INSTALLATION -INTERIOR DRY METHOD (TAPE AND TAPE)

- A. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
- C. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
- D. Place glazing tape on free perimeter of glazing in same manner described above.
- E. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- F. Knife trim protruding tape.

3.7 INSTALLATION -INTERIOR WET/DRY METHOD (TAPE AND SEALANT)

- A. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch (1.6 mm) above sight line.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
- C. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
- D. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.
- E. Fill gaps between pane and applied stop with SJ-3 type sealant to depth equal to bite on glazing, to uniform and level line.
- F. Trim protruding tape edge.

3.8 INSTALLATION -INTERIOR WET METHOD (COMPOUND AND COMPOUND)

- A. Install glazing resting on setting blocks. Install applied stop and center pane by use of spacer shims at 24 inch centers, kept 1/4 inch below sight line.
- B. Locate and secure glazing pane using glazers' clips.
- C. Fill gaps between glazing and stops with glazing compound until flush with sight line. Tool surface to straight line.

3.9 MANUFACTURER'S FIELD SERVICES

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- B. Monitor and report installation procedures and unacceptable conditions.

3.10 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

3.11 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

3.12 SCHEDULE

- A. See Drawings for locations of glass types.

END OF SECTION

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SECTION 09 20 00

GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum board.
- B. Related Sections include the following:
 - 1. Division 9 Section "Painting" for primers and finishes applied to gypsum board surfaces.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For the following products:
 - 1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.
 - 2. Finishes: Level 4 and 5 of gypsum board finish indicated for use in exposed locations. 4 by 4 foot sample.
 - a. Finishes: For each finish indicated and on same backing indicated for Work.

1.4 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency acceptable to authorities having jurisdiction.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Install mockups for the following:

- a. Each level of gypsum board finish indicated for use in exposed locations.
 - b. Each finish indicated.
 - c. Each areas such as walls, ceilings, and soffits.
2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or blotchy surface contamination and discoloration.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of gypsum board that fails in materials or workmanship within specified warranty period.
 1. Warranty Period: 1 year.
- B. Installer's Warranty: 1 year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Interior Gypsum Board: Subject to compliance with requirements, provide products by one of the following:

1. USG Corporation.
 2. National Gypsum Company.
 3. G-P Gypsum.
 4. Or equal.
- B. Steel Trim Accessories: Subject to compliance with requirements, provide products by one of the following:
1. USG Corporation.
 2. Amico.
 3. Or equal.
- C. Aluminum Trim: Subject to compliance with requirements, provide products by one of the following:
1. Fry Reglet Corp.
 2. Gordon, Inc.
 3. Pittcon Industries.
 4. Brand X Metals, Inc.
 5. Or equal.

2.2 PANELS, GENERAL

- A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36 or ASTM C 1396, as applicable to type of gypsum board indicated and whichever is more stringent.
- B. Type X:
1. Thickness: 5/8 inch.
 2. Long Edges: Tapered.

2.4 TRIM ACCESSORIES

- A. Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - f. Expansion (control) joint.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.

- B. Aluminum Trim and Reveal: As specified in Division 9 Section "Portland Cement Plaster".

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape: Paper.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
- C. Acoustical Sealant: Sheetrock Acoustical Sealant by USG or equal.
- D. Thermal and Acoustical Insulation: As specified in Division 7 Section "Building Insulation."
- E. Gypsum Board Adhesives: High performance latex-based construction adhesive designed for gypsum board applications.
 - 1. Green Series SW-325 Shear & Drywall Adhesive by OSI.
 - 2. Drywall Adhesive GDWA by Grabberman.
 - 3. Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.

- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.3 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners, unless otherwise indicated.
 - 2. LC-Bead: Use at exposed panel edges.
 - 3. L-Bead: Use where indicated.
 - 4. U-Bead: Use at exposed panel edges.
 - 5. Curved-Edge Cornerbead: Use at curved openings.
- D. Aluminum Trim: Install in locations indicated on Drawings Insert requirements.

3.4 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Comply with GA 214 for Level definitions.
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for ceramic tile or acoustical tile.
 - 3. Level 3: Where indicated on Drawings.
 - 4. Level 4: At panel surfaces that will be exposed to view with flat paint finish.
 - a. Primer and its application to surfaces are specified in other Division 9 Sections.
 - 5. Level 5: At panel surfaces that will be exposed to view with non-flat paint finish.
 - a. Primer and its application to surfaces are specified in other Division 9 Sections.

3.5 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09 51 10

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes acoustical panels and suspension systems for ceilings.
- B. Related Sections include the following:
 - 1. Division 7 Section "Joint Sealers" for acoustical sealant requirements.

1.3 DEFINITIONS

- A. AC: Articulation Class.
- B. CAC: Ceiling Attenuation Class.
- C. LR: Light Reflectance coefficient.
- D. NRC: Noise Reduction Coefficient.

1.4 SYSTEM DESCRIPTION

- A. DSA Interpretation of Regulations (IR) Document Metal Suspension Systems for Lay In Panel Ceilings (IR25-2.13) references 2016 CBC, Section 1616 A.1.20.
 - 1. Applies to ceiling systems whose total weight, including air conditioning grilles and light fixtures, does not exceed four (4) psf. Heavier systems and those supporting lateral loads from partitions will require special design details.
 - 2. SUSPENSION SYSTEM COMPONENTS: Shall comply with ASTM C635 and Section 5.1 of ASTM E580.
 - a. The ceiling grid system must be rated heavy duty as defined by ASTM C635. 2.2

- b. Suspension wires shall be #12 gage (0.106" diameter), soft annealed, and galvanized steel wires with Class 1 coating.
 - c. Main runners, cross runners, splices, expansion devices, and intersection connectors shall be designed to carry a mean ultimate test load of not less than 180 lbs. in compression and tension per ASTM E580 Section 5.1.2.
3. SUSPENSION SYSTEM INSTALLATION: Shall comply with ASTM C636 and Section 5.2 of ASTM E580.
- a. #12 gage hanger wires may be used for up to and including a 4 foot by 4 foot grid spacing and shall be attached to main runners. 3.2
 - b. Provide #12 gage hanger wires at the ends of all main and cross runners within eight (8) inches of the support or within one-fourth (1/4) of the length of the end tee, whichever is least, for the perimeter of the ceiling area.
 - c. Perimeter wires are not required when the length of the end tee is eight (8) inches or less, breaks, soffits or discontinuous areas. Hanger wires that are more than 1 in 6 out of plumb are to have counter sloping wires.
 - d. Ceiling grid members shall be attached to two (2) adjacent walls per ASTM E580, Section 5.2.3. Ceiling grid members shall be at least 3/4 inch clear of other walls. If walls run diagonally to ceiling grid system runners, one end of main and cross runners should be free, and a minimum of 3/4 inch clear of wall.
 - e. The width of the perimeter supporting closure angle shall be not less than 2 inches. Grid systems with specialty angles and support clips may be acceptable in accordance with Section 11 below.
At the perimeter of the ceiling area where main or cross runners are not connected to the adjacent wall, provide interconnection between the runners at the free end to prevent lateral spreading. A metal strut or a 16 ga. wire with a positive mechanical connection to the runner may be used. Where the perpendicular distance from the wall to the first parallel runner is 12 inch or less, this interlock is not required.
4. LATERAL FORCE BRACING: Lateral force bracing is required per this section for all ceiling areas. The spacing of the bracing assemblies must be shown on the construction documents.
- a. Exception: Lateral force bracing may be omitted for suspended acoustical ceiling systems with a ceiling area of 144 square feet or less, and fire rated suspended acoustical ceiling systems with a ceiling area of 96 square feet or less, when perimeter support, in accordance with Section 3.4 of this IR or with ASTM E580 Sections 5.2.2 and 5.2.3, are provided and perimeter walls are designed to carry the ceiling lateral forces.
 - b. Provide lateral force bracing assemblies consisting of a compression strut and four (4) #12 gage splayed bracing wires oriented 90 degrees from each other
 - c. Lateral force bracing assemblies shall be spaced at a maximum of 12 feet by 12 feet on centers for school buildings and 8 feet by 12 feet on centers for essential services buildings. There shall be a brace assembly a distance of not more than one half of the above spacing from each surrounding wall, expansion joint and at the edges of any ceiling vertical offsets.
 - d. The slope of bracing wires shall not exceed 45 degrees from the plane of the ceiling and wires shall be taut. Splices in wires are not permitted without DSA approval.
 - e. Compression struts shall be adequate to resist the vertical component induced by the bracing wires, and shall not be more than one (horizontal) in six (vertical) out of plumb.
5. ATTACHMENT OF HANGER AND BRACING WIRES:

- a. Fasten hanger wires with not less than three (3) tight turns in three (3) inches. Hanger wire loops shall be tightly wrapped and sharply bent to prevent any vertical movement or rotation of the member within the loops (see ASTM E580, Section 5.2.7.2).
Fasten #10 or #12 bracing wires with four (4) tight turns. Make all tight turns within a distance of 1-1/2 inches.
 - b. Hanger or bracing wire anchored to the structure should be installed in such a manner that the direction of the anchor aligns as closely as possible with the direction of the wire.
 - c. Separate all ceiling hanger and bracing wires at least six (6) inches from all unbraced ducts, pipes, conduit, etc.
 - d. Hanger wires shall not attach to or bend around interfering material or equipment. Provide trapeze or other supplementary support members at obstructions to typical hanger spacing. Provide additional hangers, struts or braces as required at all ceiling breaks, soffits, or discontinuous areas.
 - e. Hanger wires that are more than one (horizontal) in six (vertical) out of plumb shall have counter-sloping wires. Perimeter hanger wires at main runners that are positively attached to the perimeter closure angle, counter-sloping is optional. Note: See ASTM C636, Figure 1, for counter-sloping methods.
 - f. When connection details differ from those in the attached figures, attachment of bracing wires to the structure above and to the main runners shall be adequate for the load imposed. The weight (Wp) shall be taken as not less than four (4) psf for calculating seismic forces (Fp).
 - g. When drilled-in concrete anchors or power actuated fasteners are used in reinforced concrete for hanger wires, 1 out of 10 wire/anchor assemblies must be field tested for 200 lbs. in tension. When drilled-in concrete anchors are used for bracing wires, 1 out of 2 wire/anchor assemblies must be field tested for 440 lbs. in tension in the direction of the wire. Power actuated fasteners in concrete are not permitted for bracing wires.
Note: Drilled-in or shot-in anchors require DSA approval prior to use in pre-stressed concrete.
6. CEILING FIXTURES, TERMINALS, AND DEVICES: All fixtures, terminals, and other devices shall be mounted in a manner that will not compromise ceiling performance in accordance with Section 13.5.6.2.2(5) of ASCE 7-10 as amended by 2016 CBC Section 1616A.1.20 (1616.10.16*) and ASTM E580 Sections 5.3 and 5.4.
- a. Ceiling panels shall not support any light fixtures, air terminals or devices.
 - b. All light fixtures shall be positively attached to the ceiling suspension systems by mechanical means to resist a horizontal force equal to the weight of the fixture. Screws or approved fasteners are required. A minimum of two attachments are required at each light fixture, per ASTM E580, Section 5.3.1.
Recessed or drop-in light fixtures, grilles, mechanical terminals, and flexible sprinkler hose fittings or other services be supported directly on runners classified as ASTM heavy duty, but they must also have a minimum of two (2) #12 gage slack safety wires attached to the fixture at diagonal corners and anchored to the structure above.
 - c. All flush or recessed light fixtures, mechanical terminals, and flexible sprinkler hose fittings or other services weighing 56 lbs. or more must be independently supported by not less than four (4) taut #12 gage wires attached to the housing and to the

structure above. The four (4) taut #12 gage wires, including their attachment to the structure above, must be capable of supporting four (4) times the weight of the unit.

- d. All four foot x four foot light fixtures must have slack safety wires at each corner unless supported per paragraph above.
- e. Surface-mounted fixtures shall be attached to the main runner with at least two positive clamping devices made of material with a minimum #14 gage. Rotational spring catches do not comply. A #12 gage suspension wire shall be attached to each clamping device to the structure above. Provide additional supports when light fixtures are eight (8) feet or longer. Maximum spacing between supports shall not exceed eight (8) feet.
- f. Support pendant-mounted light fixtures directly from the structure above with hanger wires or cables passing through each pendant hanger and capable of supporting two (2) times the weight of the fixture. See IR 16-9 for additional requirements for pendant mounted fixtures.

If the pendant mounted light fixture is directly and independently braced below the ceiling, i.e., aircraft cables to walls, then a brace assembly is not required above the ceiling.

If the pendant mounted light fixture is not directly and independently braced below the ceiling, then a bracing assembly, per Figure 1, is required where the pendant hanger penetrates the ceiling. Special details are required to attach the pendant hanger to the bracing assembly to transmit the horizontal force. Exception: Where the weight of the fixture is less than 20 pounds, the compression post shown in Figure 1 is not required.

All lightweight miscellaneous devices, such as strobe lights, speakers, etc., shall be attached to the ceiling grid per Section 7.1 of this IR. In addition, devices weighing more than 10 lbs shall have a #12 slack safety wire anchored to the structure above. Devices weighing more than 20 lbs shall be supported from the structure above per Section 7.3 of this IR.

7. Services within the Ceiling:

- a. All flexible sprinkler hose fittings, ceiling-mounted air terminals or other services shall be positively attached to the ceiling suspension systems by mechanical means to resist a horizontal force equal to the weight of the component. Screws or approved fasteners are required. A minimum of two attachments are required at each component.
- b. Flexible sprinkler hose fittings, ceiling-mounted air terminals or other services weighing less than or equal to 20 lb. shall have one (1) #12 gage slack safety wire attached to the terminal or service to the structure above.
- c. Flexible sprinkler hose fittings, ceiling-mounted air terminals or other services weighing more than 20 lb. but less than or equal to 56 lb. shall have two (2) #12 gage slack safety wires attached to the terminal or service to the structure above.
- d. Flexible sprinkler hose fittings, ceiling-mounted air terminals or other services weighing more than 56 lb. shall be supported directly from the structure above by not less than four (4) taut #12 gage wires attached to the terminal or service and to the structure above. The four (4) taut #12 gage wires, including their attachment to the structure above, must be capable of supporting four (4) times the weight of the unit.
- e. Other Devices within the Ceiling:
- f. All lightweight miscellaneous devices, such as strobe lights, occupancy sensors, speakers, exit signs, etc., shall be attached to the ceiling grid per Section 7.3.1 of the

IR. In addition, devices weighing more than 10 lbs. shall have a #12 gage slack safety wire anchored to the structure above per Section 7.2.2 of the IR. Devices weighing more than 20 lbs. shall be supported from the structure above per Section 7.3.4 of this IR.

8. ADDITIONAL REQUIREMENTS:

- a. Fire Rated Ceilings: Provide a detail and design number for rated ceiling assemblies from an authorized testing agency. The components and installation details must conform in every respect with the listed detail and number. Details shall clearly depict all components, including insulation materials, framing and attachment of the design so that the assembly can be constructed and inspected accordingly. Pop rivets, screws, or other attachments are not acceptable unless specifically detailed on the drawings and approved by U.L. and State Fire Marshal (SFM) recognized laboratories.
- b. Metal and Other Panels: Metal panels and panels weighing more than one-half (1/2) psf, other than mineral fiber acoustical tile, are to be positively attached to the ceiling suspension runners.
- c. Essential Services Buildings: Exit ways shall be installed in accordance with Section 13.5.6.2.2(1) of ASCE 7-10 as amended by 2016 CBC Section 1616A.1.20 (1616.10.16*). A main or cross runner shall be installed on all sides of each piece of tile, board or panel and each light fixture or grill (see Figure 7, Detail B). Splices or intersection of such runners shall be attached with through connectors such as pop rivets, screws, pins, plates with end tabs or other approved connectors.
- d. Suspended Acoustical Ceilings Below Gypsum Board Ceilings: Where gypsum board or other ceiling finishes are attached to the framing, specific details will be required for the vertical hanger wire and lateral bracing wire support connections to the framing.

B. Structural Performance:

1. IBC Seismic Categories D, E, F.
2. Heavy Duty Grid.
3. Minimum 3/4 inch clearance from grid end to wall.
4. Minimum 2 inch perimeter molding.
5. Grid must be attached on 2 adjacent walls, no attachment on other 2 walls.
6. Perimeter T ends tied together at perimeters on tees that are not attached to perimeter molding.
7. Partition attachment bracing is required to be independent from ceiling splay bracing.
8. Seismic separation joint required for areas greater than 2,500 sq. ft. (or full height partitions).
9. Rigid bracing required for ceiling elevation changes.
10. Interior suspended ceilings, soffits, and bulkheads: Maintain deflection of not more than L/360 of distance between supports.

1.5 SUBMITTALS

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

- B. Samples for Initial Selection: For components with factory-applied color finishes.
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Panel: Set of 6-inch- square Samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- long Samples of each type, finish, and color.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.
- E. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor and fastener type.
- F. Maintenance Data: For finishes to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. 2016 Building Standards Administrative Code, Part 1, CBSC.
 - 2. 2016 California Building Safety Code (CBSC), Part 2, CBSC (2015 IBC & California Amendments).
 - 3. 2016 California Electrical Code (CEC), Part 3, CBSC (2014 National Electrical Code & California Amendments).
 - 4. 2016 California Mechanical Code (CMC), Part 4, CBSC (2015 Uniform Mechanical Code & California Amendments).
 - 5. 2016 California Plumbing Code (CPC), Part 5, CBSC (2015 Uniform Plumbing Code & California Amendments).
 - 6. 2016 California Energy Code, Part 6, CBSC.
 - 7. 2016 California Historical Building Code, Part 8, CBSC.
 - 8. 2016 California Fire Code, Part 9, CBSC (2015 International Fire Code & California Amendments).
 - 9. 2016 California referenced Standards, Part 12 CBSC.
- B. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
- C. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

- D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
 - 1. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
 - a. Smoke-Developed Index: 450 or less.
 - b. Flame-Spread Classification: CBC 802.2 and Table 8-A.
 - 1) Flame-Spread Rating: Class 1 (0-25).
- E. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
 - 1. UBC Standard 25-2, "Metal Suspension Systems for Acoustical Tile and for Lay-in Panel Ceilings."
- F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.9 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of acoustical panel ceilings that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: 1 year.
- B. Installer's Warranty: 1 year.

1.11 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
 - 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.
 - 3. Hold-Down Clips: Equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acoustical Panels: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
 - 1. Armstrong World Industries, Inc. (Basis of Design)
 - 2. USG Interiors, Inc.
 - 3. Rockfon North America
 - 4. Or equal.
- B. Suspension Systems: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
 - 1. Armstrong World Industries, Inc. (Basis of Design)
 - 2. USG Interiors, Inc.
 - 3. Rockfon North America.
 - 4. Or equal.

2.2 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.

2.3 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

- A. Acceptable Product: Ultima by Armstrong World Industries (Location per plans and finish schedule)
 - 1. Surface Texture: Fine.
 - 2. Composition: Mineral Fiber.
 - 3. Color: White.
 - 4. Size: Per drawings
 - 5. Edge Profile: Beveled Tegal for interface with Prelude XL 15/16" Exposed Tee.
 - 6. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton, 0.70
 - 7. Ceiling Attenuation Class (CAC): ASTM C 1414; Classified with UL label on product carton, 42.
 - 8. Emissions Testing: Section 01350 Protocol, < 13.5 ppb of formaldehyde when used under typical conditions required by ASHRAE Standard 62.1-2004, "Ventilation for Acceptable Indoor Air Quality".
 - 9. Flame Spread: ASTM E 1264; Class A (UL).
 - 10. Light Reflectance (LR): ASTM E 1477; White Panel: Light Reflectance: 0.85.
 - 11. Dimensional Stability: Standard -Space is enclosed, weatherproofed, HVAC systems operating.
 - 12. Antimicrobial Protection: BioBlock Plus - Resistance against the growth of mold/mildew and gram positive and gram negative odor and stain causing bacteria.
- B. Acceptable Product: Optima PB by Armstrong World Industries.
 - 1. Surface Texture: Smooth Texture
 - 2. Composition: Fiberglass with acoustically transparent membrane
 - 3. Color: White.
 - 4. Size: Per drawings
 - 5. Edge Profile: Square Tegal for interface with Prelude XL 15/16" Exposed Tee.
 - 6. Noise Reduction Coefficient (NRC): ASTM C 423; Classified with UL label on product carton, 0.95
 - 7. Ceiling Attenuation Class (CAC): N/A
 - 8. Emissions Testing: Section 01350 Protocol, < 13.5 ppb of formaldehyde when used under typical conditions required by ASHRAE Standard 62.1-2004, "Ventilation for Acceptable Indoor Air Quality".
 - 9. Flame Spread: ASTM E 1264; Class A (UL).
 - 10. Light Reflectance (LR): ASTM E 1477; White Panel: Light Reflectance: 0.85.
 - 11. Dimensional Stability: Standard -Space is enclosed, weatherproofed, HVAC systems operating.

12. Antimicrobial Protection: BioBlock Plus - Resistance against the growth of mold/mildew and gram positive and gram negative odor and stain causing bacteria.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- C. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641, Class 1 zinc coating, soft temper.
 2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 12 gauge (0.106") diameter.
- E. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- F. Angle Hangers: Angles with legs not less than 2 inch wide; formed with 0.04-inch- thick, galvanized steel sheet complying with ASTM A 653, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.
- G. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- H. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- I. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.
- J. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

- K. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.5 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

- A. Exposed Steel Suspension System: Formed galvanized steel, commercial quality cold rolled; heavy-duty.
 - 1. Product: 7301 Prelude XL by Armstrong, ICC# ESR 1308.
 - a. Profile: Tee; 15/16-inch-wide face.
 - b. Construction: Double web.
 - c. Structural Classification: ASTM C 635 Heavy-Duty.
 - d. Finish: Factory painted white.

2.6 METAL EDGE TRIM

- A. Extruded aluminum perimeter trim: As indicated on drawings. Same color and finish as that used for exposed flanges of suspension system runners.
 - 1. Product: Armstrong Axiom Classic Trim, 6" high Trim Channel

2.7 ACOUSTICAL SEALANT

- A. Comply with requirement of Division 7 "Joint Sealants".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with IR 25-2.13 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counters playing, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of approved trapezes or equivalent devices.
 - 4. Where width of ducts and other construction within ceiling plenum interferes with location of required bracing and compression struts, install supplemental suspension members and hangers in form of approved trapezes or equivalent devices.
 - 5. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 - 6. Do not attach hangers to steel deck tabs.
 - 7. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 - 8. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post installed anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 - 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - 2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - 4. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

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SECTION 09 68 13

CARPET TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes modular, carpet tile.
- B. Related Sections include the following:
 - 1. Division 9 Section "Resilient Wall Base and Accessories" for resilient wall base and accessories installed with carpet.
 - 2. Division 9 Section "Carpet."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Existing flooring materials to be removed.
 - 3. Existing flooring materials to remain.
 - 4. Carpet tile type, color, and dye lot.
 - 5. Type of subfloor.
 - 6. Type of installation.
 - 7. Pattern of installation.
 - 8. Pattern type, location, and direction.
 - 9. Pile direction.
 - 10. Type, color, and location of insets and borders.
 - 11. Type, color, and location of edge, transition, and other accessory strips.
 - 12. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
 2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- long Samples.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- E. Qualification Data: For Installer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.
- G. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
- H. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Provide glue down or firm cushion installation that complies with CBC section 1124B.3
- D. Carpet shall have a level loop, textured loop, level-cut or level-cut/uncut pile texture and maximum pile height of ½" per CBC section 1124B.3
- E. Carpet edges shall comply with CBC section 1124B.2

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section 5, "Storage and Handling."

1.6 PROJECT CONDITIONS

- A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."
- B. Environmental Limitations: Do not install carpet tiles until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.7 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
- B. Installer's Warranty: 1 year.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Carpet Tile: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
 - 1. Shaw Contract (Basis of Design)
 - 2. Mohawk
 - 3. Lees
 - 4. Bentley Prince Street
 - 5. Interface
 - 6. Or equal.

2.2 CARPET TILE

- A. Product: Shaw Contract Group.
 - 1. Style Name: Cut & Compose Rotate Tile 5T105
 - 2. Color: Abstract 03481
 - 3. Collection: To be Selected
 - 4. Product Type: Tile
 - 5. Construction: Multi Level Pattern loop

6. Fiber: Eco Solution Q Nylon
7. Protective treatments – SSP Shaw soil protection
8. Primary Backing: Synthetic
9. Secondary Backing: Ecoworx Tile
10. Gauge: 1/12.
11. Density: 6712.
12. Total Thickness: 0.252
13. Stitches per Inch: 11.0.
14. Finished Pile Thickness: .0.118
15. Dye Method: 92% Solution Dyed/8% yarn Died
16. Pattern Repeat: Not Applicable
17. Tufted Weight: 22.0 oz. per. Sq. yd.
18. Size/Width: **24"x24"**
19. Installation Method: Glued Down
20. Indoor Air Quality: Green Label Plus 1098.
21. Foot Traffic Recommendation TARR: Severe
22. NSF 140: Gold.
23. Static:less than 3.5 kv
24. Flammability: Passes DOC-FF-1-70 Pill Test
25. Flooring Radiant Panel Test: Meets NFPA Class 1 when tested under ASTM E-648 glue down
26. Smoke Density: NBS Smoke Chamber NFPA-258 - Less than 450 Flaming ModeWarranties:
 - a. Lifetime Limited Modular Warranty.
 - b. Lifetime Stain Warranty.
 - c. Lifetime Static.

B. Product: Shaw Contract Group.

1. Style Name: To be Selected
2. Color: To be Selected
3. Collection: To be Selected
4. Product Type: Tile
5. Construction: Multi Level Pattern cut/loop
6. Fiber: Eco Solution Q Nylon
7. Primary Backing: Synthetic
8. Secondary Backing: Ecoworx Tile
9. Protective treatments – SSP Shaw soil protection
10. Gauge: 1/12.
11. Density: 8129.
12. Total Thickness: 0.268
13. Stitches per Inch: 10.0.
14. Finished Pile Thickness: .0.124
15. Dye Method: 80% Solution Dyed/20% yarn Died
16. Pattern Repeat: Not Applicable
17. Tufted Weight: 28.0 oz. per. Sq. yd.
18. Size/Width: 24" x 24".
19. Installation Method: Lock Dot System
20. Indoor Air Quality: Green Label Plus 1098.
21. Foot Traffic Recommendation TARR: Severe

22. NSF 140: Gold.
 23. Static: less than 3.5 kv
 24. Flammability: Passes DOC-FF-1-70 Pill Test
 25. Flooring Radiant Panel Test: Meets NFPA Class 1 when tested under ASTM E-648 glue down
 26. Smoke Density: NBS Smoke Chamber NFPA-258 - Less than 450 Flaming Mode Warranties:
 - a. Lifetime Limited Modular Warranty.
 - b. Lifetime Stain Warranty.
 - c. Lifetime Static.
- C. Product: Shaw Contract Group.
1. Style Name: To be Selected
 2. Color: To be Selected
 3. Collection: Couture Inspired by Wool
 4. Product Type: Tile
 5. Construction: Multi Level Pattern cut/loop
 6. Fiber: Eco Solution Q Nylon
 7. Primary Backing: Synthetic
 8. Secondary Backing: Ecoworx Tile
 9. Protective treatments – SSP Shaw soil protection
 10. Gauge: 1/12.
 11. Density: 8941.
 12. Total Thickness: 0.295
 13. Stitches per Inch: 10.0.
 14. Finished Pile Thickness: .0.153
 15. Dye Method: 41% Solution Dyed/59% yarn Died
 16. Pattern Repeat: Not Applicable
 17. Tufted Weight: 38.0 oz. per. Sq. yd.
 18. Size/Width: 24" x 24".
 19. Installation Method: Lock Dot System
 20. Indoor Air Quality: Green Label Plus 1098.
 21. Foot Traffic Recommendation TARR: Severe
 22. NSF 140: Gold.
 23. Static: less than 3.5 kv
 24. Flammability: Passes DOC-FF-1-70 Pill Test
 25. Flooring Radiant Panel Test: Meets NFPA Class 1 when tested under ASTM E-648 glue down
 26. Smoke Density: NBS Smoke Chamber NFPA-258 - Less than 450 Flaming Mode Warranties:
 - a. Lifetime Limited Modular Warranty.
 - b. Lifetime Stain Warranty.
 - c. Lifetime Static.

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, non staining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and as recommended/ required by the manufacturer for warrantee acceptance or provided by carpet tile manufacturer for the type of carpet being installed.
 - 1. VOC Limits: Provide adhesives that comply with the following limits for VOC content when tested according to ASTM D 5116:
 - a. Total VOCs: 10.00 mg/sq. m x h.
 - b. Formaldehyde: 0.05 mg/sq. m x h.
 - c. 2-Ethyl-1-Hexanol: 3.00 mg/sq. m x h.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Substrates:
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Maintain dye lot integrity. Do not mix dye lots in same area.
- C. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- D. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- F. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protection of Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

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SECTION 09 90 00

PAINTING AND COATING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

1. Field application of paints, stains, varnishes, and other coatings.
2. Materials for backpriming woodwork.
3. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - a. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - b. Elevator pit ladders.
 - c. Exposed surfaces of steel lintels and ledge angles
 - d. Surfaces inside cabinets.
 - e. Prime surfaces to receive wall coverings.
 - f. Interior walls and bottom of swimming pools and fountains.
 - g. Mechanical and Electrical:
 - 1) In finished areas, paint all insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - 2) In finished areas, paint shop-primed items.
 - 3) On the roof and outdoors, paint all equipment that is exposed to weather or to view, including that which is factory-finished.
 - 4) Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
 - 5) Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

B. Do Not Paint or Finish the Following Items:

1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
2. Items indicated to receive other finishes.
3. Items indicated to remain unfinished.
4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
5. Non-metallic roofing and flashing.
6. Stainless steel, anodized aluminum, bronze, terne, and lead items.
7. Marble, granite, slate, and other natural stones.
8. Floors, unless specifically so indicated.
9. Ceramic and other tiles.
10. Brick, architectural concrete, cast stone.

11. Exterior insulation and finish system (EIFS).
12. Glass.
13. Concrete masonry in utility, mechanical, and electrical spaces.
14. Acoustical materials, unless specifically so indicated.
15. Concealed pipes, ducts, and conduits.

1.2 RELATED SECTIONS

1.3 DEFINITIONS

- A. Conform to ASTM D 16 for interpretation of terms used in this section.
- B. Dry film thickness (DFT): Thickness of a coat of paint in fully cured state measured in mils (1/1000-inch).
- C. Paint The term, as used in this Section, means all coating system components, including primers, emulsions, enamels, varnishes, stains, lacquers, sealers, fillers, and other applied materials whether used as prime, intermediate or finish coat.
- D. Sheen: The terms used in these Specifications refer to the following gloss ranges when tested in accordance with ASTM D 523 test method.

Name	ASTM D 523 Test Method	Gloss Range
Flat	60-degree meter	0 to 7
Low Sheen	60-degree meter	10 to 15
Eggshell	60-degree meter	25 to 30
Semi-gloss	60-degree meter	55 to 60
Gloss	60-degree meter	Gloss Range

1.4 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures.
- B. Product Data: Provide data on all finishing products, including VOC content.
- C. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on tempered hardboard, 9 x 12 inch in size.
- D. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.
- E. Manufacturer's Instructions: Indicate special surface preparation procedures.
- F. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.
2. Extra Paint and Coatings: 1 gallon of each color; store where directed.
3. Label each container with color in addition to the manufacturer's label.

1.5 QUALITY ASSURANCE

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

1.6 REGULATORY REQUIREMENTS

- A. Conform to SCAQMD standards for VOC requirements for products and finishes.

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.
- F. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

- G. Sustainable Design Submittals: Provide the following information by filling out the Special Environmental Requirements Product Submittal Form located in Appendix A of Section 01 35 43 Special Environmental Requirements.
 - 1. Low Emitting Materials
 - 2. Local/Regional Materials
- H. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Provide all paint and coating products from the same manufacturer to the greatest extent possible. All submitted paint products shall be first line, top quality, architectural grade products. Paint products described as commercial or professional grade will not be considered.
- C. Paints:
 - 1. Base Manufacturer: Dunn Edwards Paint Company, www.dunnedwards.com.
 - 2. Vista Paint Company; www.vistapaint.com.
 - 3. Glidden Professional: www.gliddenprofessional.com.
 - 4. Sherwin-Williams Company: www.sherwin-williams.com.
- D. Transparent Finishes:
 - 1. Base Manufacturer: Deft & McCloskey distributed by Vista Paint.
- E. Stains:
 - 1. Sherwin-Williams Company: www.sherwin-williams.com.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 PAINTING AND COATING - GENERAL

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
 - 1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 - 3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
 - 4. Supply each coating material in quantity required to complete entire project's work from a single production run.
 - 5. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.

- B. Primers: Where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Volatile Organic Compound (VOC) Content:
 - 1. Provide coatings that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; www.otcair.org; specifically:
 - 1) Opaque, Flat: 50 g/L, maximum.
 - 2) Opaque, Nonflat: 150 g/L, maximum.
 - 3) Opaque, High Gloss: 250 g/L, maximum.
 - 4) Varnishes: 350 g/L, maximum.
 - a) Architectural coatings VOC limits of State in which the project is located.
 - b) USGBC LEED Rating System, edition as stated in Section 01 3543; for interior wall and ceiling finish (all coats), anti-corrosive paints on interior ferrous metal, clear wood stains and finishes, sanding sealers, other sealers, shellac, and floor coatings.
 - 5) Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- D. Chemical Content: The following compounds are prohibited:
 - 1. Aromatic Compounds: In excess of 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 - 2. Acrolein, acrylonitrile, antimony, benzene, butyl benzyl phthalate, cadmium, di (2-ethylhexyl) phthalate, di-n-butyl phthalate, di-n-octyl phthalate, 1,2-dichlorobenzene, diethyl phthalate, dimethyl phthalate, ethylbenzene, formaldehyde, hexavalent chromium, isophorone, lead, mercury, methyl ethyl ketone, methyl isobutyl ketone, methylene chloride, naphthalene, toluene (methyl benzene), 1,1, 1-trichloroethane, vinyl chloride.
- E. Colors: As indicated on drawings
 - 1. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
 - 2. Extend colors to surface edges; colors may change at any edge as directed by Architect.
 - 3. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.
 - 4. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color-coding scheme indicated.

2.3 PAINTING SYSTEMS – EXTERIOR

- A. Paint WE-OP-3L - Wood, Opaque, Latex, 3 Coat:
 - 1. One coat of latex primer sealer.
 - 2. Gloss: Two coats of latex enamel; 8500 Carefree 100% Acrylic Gloss.

3. Semi-gloss: Two coats of latex enamel; 8400 Carefree 100% Acrylic Semi-Gloss.
- B. Paint WE-TR-V - Wood, Transparent, Varnish, No Stain:
 1. One coat sealer.
 2. Gloss: One coat of varnish; McCloskey's 6509 Spar Varnish.
 3. Satin: One coat of varnish; McCloskey's 6509 Spar Varnish.
 4. Flat: One coat of varnish; McCloskey's 6509 Spar Varnish
- C. Paint WE-TR-VS - Wood, Transparent, Varnish, Stain:
 1. Filler coat (for open grained wood only).
 2. One coat of stain; Monochem Aquaseal SIT Stain.
 3. One coat sealer; Not Required.
 4. Gloss: One coat of varnish; McCloskey's 6509 Spar Varnish.
 5. Satin: One coat of varnish; McCloskey's 6509 Spar Varnish.
- D. Paint WE-TR-S - Wood, Transparent, Sealer, Optional Stain:
 1. One coat of stain; Monochem Aquaseal SIT Stain.
 2. One coat of clear sealer; Monochem Aquaseal II for Wood.
- E. Paint CE-OP-3L - Masonry/Concrete, Opaque, Latex, 3 Coat:
 1. One coat of 100% acrylic block filler.
 2. Semi-gloss: Two coats of latex enamel; 8400 Carefree 100% Acrylic Semi-Gloss.
 3. Flat: Two coats of latex enamel; 2000 Duratone 100% Acrylic Flat.
- F. Paint GE-OP-3L - Gypsum Board and Plaster, Opaque, Latex, 3 Coat:
 1. One coat of latex primer sealer.
 2. Flat: Two coats of latex; 2000 Duratone 100% Acrylic Flat.
- G. Paint ME-OP-3L - Ferrous Metals, Unprimed, Latex, 3 Coat:
 1. One coat of latex rust-inhibitive primer.
 2. Gloss: Two coats of latex enamel; 8500 Carefree 100% Acrylic Gloss
 3. Semi-gloss: Two coats of latex enamel: 8400 Carefree 100% Acrylic Semi-Gloss
 2. Gloss: Two coats of latex enamel; 8500 Carefree 100% Acrylic Gloss.
 3. Semi-gloss: Two coats of latex enamel: 8400 Carefree 100% Acrylic Semi-Gloss.
- H. Paint ME-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:
 1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
 2. Gloss: Two coats of latex enamel: 8500 Carefree 100% Acrylic Gloss.
 3. Semi-gloss: Two coats of latex enamel; 8400 Carefree 100% Acrylic Semi-Gloss.
- I. Paint MgE-OP-3L - Galvanized Metals, Latex, 3 Coat:
 1. One coat acrylic galvanizing primer.
 2. Gloss: Two coats of latex enamel; 8500 Carefree 100% Acrylic Gloss
 3. Semi-gloss: Two coats of latex enamel; 8400 Carefree 100% Acrylic Semi-Gloss
 2. Gloss: Two coats of latex enamel; 8500 Carefree 100% Acrylic Gloss.
 3. Semi-gloss: Two coats of latex enamel; 8400 Carefree 100% Acrylic Semi-Gloss.
- J. Paint Copper-Ox - Copper, Natural Oxidized Finish:

1. Rub on oxidizing solution of copper acetate and ammonium chloride in acetic acid, until required effect is achieved.
2. Rinse surfaces with clear water and allow to dry.

K. Paint E-Pav - Pavement Marking Paint:

1. Yellow: One coat, with reflective particles; 6900 On-Line Traffic Paint
2. White: One coat, with reflective particles; 7200 Optiline White.

2.4 PAINTING SYSTEMS – INTERIOR

A. Paint WI-OP-3L - Wood, Opaque, Latex, 3 Coat:

1. One coat of latex primer sealer.
2. Gloss: Two coats of latex enamel; 8500 Carefree 100% Acrylic Gloss
3. Semi-gloss: Two coats of latex enamel: 8400/6400 Carefree 100% Acrylic Semi-Gloss
4. Eggshell: Two coats of latex enamel; 8300/6300 Carefree 100% Acrylic Eggshell
5. Flat: Two coats of latex enamel; 8100/6100 Carefree Flat

B. Paint WI-TR-V - Wood, Transparent, Varnish, No Stain:

1. One coat sealer.
2. Gloss: One coat of varnish; 108 Acrithane Gloss
3. Satin: One coat of varnish; 109 Acrithane Semi-Gloss
4. Flat: One coat of varnish; NA

C. Paint WI-TR-VS - Wood, Transparent, Varnish, Stain:

1. Filler coat (for open grained wood only).
2. One coat of stain; Deft SIT Stain
3. One coat sealer; Deft WB SS 015
4. Gloss: One coat of varnish; 108 Acrithane Gloss
5. Satin: One coat of varnish; 109 Acrithane Semi-Gloss
6. Flat: One coat of varnish; NA

D. Paint CI-OP-3L - Concrete/Masonry, Opaque, Latex, 3 Coat:

1. One coat of 100% acrylic block filler.
2. Semi-gloss: Two coats of latex enamel; 8400/6400 Carefree 100% Acrylic Semi-Gloss.
3. Flat: Two coats of latex enamel; 8100/6100 Carefree Flat.

E. Paint MI-OP-3L - Ferrous Metals, Unprimed, Latex, 3 Coat:

1. One coat of latex, corrosion resistant primer.
2. Gloss: Two coats of latex enamel; 8500 Carefree 100% Acrylic Gloss.
3. Semi-gloss: Two coats of latex enamel: 8400/6400 Carefree 100% Acrylic Semi-Gloss.

F. Paint MI-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat:

1. Touch-up with latex corrosion resistant primer.
2. Gloss: One coat of latex enamel; 8500 Carefree 100% Acrylic Gloss.
3. Semi-gloss: Two coat of latex enamel: 8400/6400 Carefree 100% Acrylic Semi-Gloss.

- G. Paint Mgl-OP-3L - Galvanized Metals, Latex, 3 Coat:
 - 1. One coat acrylic galvanizing primer.
 - 2. Gloss: Two coats of latex enamel; 8500 Carefree 100% Acrylic Gloss.
 - 3. Semi-gloss: Two coats of latex enamel: 8400/6400 Carefree 100% Acrylic Semi-Gloss.
- H. Paint Mal-OP-3L - Aluminum, Unprimed, Latex, 3 Coat:
 - 1. One coat etching primer.
 - 2. Gloss: Two coats of latex enamel; 8500 Carefree 100% Acrylic Gloss.
 - 3. Semi-gloss: Two coats of latex enamel: 8400/6400 Carefree 100% Acrylic Semi-Gloss.
- I. Paint CI-OP-3E - Concrete/Masonry, Epoxy Enamel, 3 Coat:
 - 1. One coat of catalyzed epoxy primer.
 - 2. Gloss: Two coats of catalyzed epoxy enamel; Sierra S-16/22 Epoxy Acrylic Enamel (distributed by Vista Paint Co.).
- J. Paint GI-OP-3L - Gypsum Board/Plaster, Latex, 3 Coat:
 - 1. One coat of acrylic primer sealer.
 - 2. Gloss: Two coats of latex enamel; 8500 Carefree 100% Acrylic Gloss.
 - 3. Semi-gloss: Two coats of latex enamel: 8400/6400 Carefree 100% Acrylic Semi-Gloss.
 - 4. Eggshell: Two coats of latex enamel; 1700 Acriglo Velva-Sheen.
 - 5. Flat: Two coats of latex enamel; 8100/6100 Carefree Flat.
- K. Paint GI-OP-3LA - Gypsum Board/Plaster, Latex-Acrylic, 3 Coat:
 - 1. One coat of acrylic primer sealer.
 - 2. Gloss: Two coats of latex enamel; 8500 Carefree 100% Acrylic Gloss.
 - 3. Semi-gloss: Two coats of latex enamel: 8400/6400 Carefree 100%.
 - 4. Eggshell: Two coats of latex enamel; 1700 Acriglo Velva-Sheen.
 - 5. Flat: Two coats of latex enamel; 8100/6100 Carefree Flat.
- L. Paint GI-P-2A - Gypsum Board/Plaster, Acrylic Primer, 2 Coat:
 - 1. Two coats of acrylic primer sealer; 4000 Uniprime II Primer / Sealer
- M. Paint I-TR-F - Fire-Retardant Coating, Intumescent:
 - 1. One coat of fire-retardant primer sealer.2. Gloss: One coat of intumescent coating, flame/smoke rating of 25/50; AID Firefilm 3 manufactured by Carboline Protective Coatings (distributed by Vista Paint)
 - 2. Gloss: One coat of intumescent coating, flame/smoke rating of 25/50; AID Firefilm 3, manufactured by Carboline Protective Coatings (distributed by Vista Paint).
- N. Paint FI-OP-3A - Fabric/Insulation Jackets, Acrylic, 3 Coat:
 - 1. One coat of acrylic primer sealer.
 - 2. Gloss: Two coats of latex enamel; 8500 Carefree 100% Acrylic Gloss
 - 3. Semi-gloss: Two coats of latex enamel: 8400/6400 Carefree 100%
 - 4. Eggshell: Two coats of latex enamel; 1700 Acriglo Velva-Sheen.
 - 5. Flat: Two coats of latex enamel; 8100/6100 Carefree Flat

2.5 ACCESSORY MATERIALS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin application of coatings until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Test shop-applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Plaster and Stucco: 12 percent.
 - 3. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 - 4. Interior Wood: 15 percent, measured in accordance with ASTM D 4442.
 - 5. Exterior Wood: 15 percent, measured in accordance with ASTM D 4442.
 - 6. Concrete Floors and Traffic Surfaces: 8 percent.

3.2 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to coating application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or repair existing coatings that exhibit surface defects.
- D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- G. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- H. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- I. Plaster Surfaces to be Painted: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- J. Asphalt, Creosote, or Bituminous Surfaces to be Painted: Remove foreign particles to permit adhesion of finishing materials. Apply latex based sealer or primer.
- K. Insulated Coverings to be Painted: Remove dirt, grease, and oil from canvas and cotton.
- L. Concrete Floors and Traffic Surfaces to be Painted: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- M. Aluminum Surfaces to be Painted: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
- N. Copper Surfaces to be Painted: Remove contamination by steam, high pressure water, or solvent washing. Apply vinyl etch primer immediately following cleaning.
- O. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- P. Corroded Steel and Iron Surfaces to be Painted: Prepare using at least SSPC-PC 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).
- Q. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- R. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

- S. Interior Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- T. Interior Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.
- U. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.
- V. Exterior Wood to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior calking compound after sealer has been applied. Prime concealed surfaces.
- W. Glue-Laminated Beams: Prior to finishing, wash surfaces with solvent, remove grease and dirt.
- X. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
- Y. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.
- C. Apply products in accordance with manufacturer's instructions.
- D. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- E. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- F. Apply each coat to uniform appearance.
- G. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- H. Sand wood and metal surfaces lightly between coats to achieve required finish.
- I. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

- J. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- K. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection.

3.5 CLEANING

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

3.6 PROTECTION

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

END OF SECTION

SECTION 10 14 24

SIGNAGE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Cast aluminum letters.
- B. Interior and Exterior signage of the following types:
 - 1. ADA compliant interior signage, without borders.
 - 2. Fire evacuation, area of rescue assistance and specialty signs.

1.2 REFERENCES

- A. California Building Code, current edition.
- B. ANSI/ICC A117.1 - Accessible and Useable Buildings and Facilities.
- C. ATBCB ADAAG - Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG); U.S. Architectural Transportation Barriers Compliance Board.

1.3 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures.
- B. Product Data: Manufacturer's descriptive literature.
- C. Shop Drawings: List sign styles, lettering, locations and dimensions of each interior and exterior signs.
- D. Selection Samples: One complete set of color chips representing manufacturer's full range of available colors.
- E. Verification Samples: Two full size samples, representing type, style and color specified including method of attachment.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements of California Building Code.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inspect products upon receipt. Store products in manufacturer's packaging until ready for installation.

1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results.

PART 2 - PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Raised (Tactile) character depth, case, and style: Raised character on sign shall be raised 1/32 inch minimum, uppercase, sans serif style, and shall be duplicated in Braille. (11B-703.2)
- B. Braille: Braille shall be contacted (Grade 2). Braille dots shall have a domed or rounded shape and shall comply with Table 11B-703.31 below. Braille shall be positioned below the corresponding text in a horizontal format, flush left or center. With multi-lined text, Braille shall be placed below the entire text. Braille shall be separated 3/8 inch minimum and 1/2 inch maximum from any other tactile characters, and 3/8 inch minimum from raised borders and decorative elements. (11B-703.2)

TABLE 11B-703.3.1 BRAILLE DIMENSIONS

MEASUREMENT RANGE	MINIMUM TO MAXIMUM
Dot base diameter	0.059 to 0.063 inch
Distance between two dots in the same cell ¹	0.100 inch
Distance between corresponding dots in adjacent cells ¹	0.300 inch
Dot height	0.025 to 0.037 inch
Distance between corresponding dots from one cell directly below ¹	0.395 to 0.400 inch

¹ Measure center to center.

- C. Raised character stroke thickness: Stroke thickness of the uppercase letter "I" shall be 15 percent maximum based on the height of the uppercase letter "I". (11B-703.2)
- D. Raised character height: Raised character height shall be 5/8 inch minimum and a maximum of 2 inches maximum based on the height of the uppercase letter "I". (11B-703.2)
- E. Raised character and line spacing: Character spacing shall be measured between the two closest points of adjacent raised character within a message, excluding word spaces. Where characters have rectangle cross sections, spacing between individual raised characters shall be 1/8 inch minimum and 4 times the raised character stroke width maximum. Where characters have the other cross sections, spacing between individual raised characters shall be 1/16 inch minimum and 4 times the raised character stroke width maximum at the base of the cross sections, and 1/8 inch minimum and 4 times the raised character stroke width maximum at the top of the cross

sections. Characters shall be separated from raised borders and decorative elements 3/8 inch minimum. Spacing between the baselines of separate lines of raised characters within a message shall be 135 percent minimum and 170 percent maximum of the raised character height. (11B-703.2)

- F. Tactile sign installation height and location: Tactile characters on signs shall be located minimum 48 inches above the finish floor or ground surface, measured from the baseline of the lowest Braille cells and 60 inches maximum above the finish floor or ground surface, measured from the baseline of the highest line of raised characters. Where a tactile sign is provided at a door, the sign shall be located alongside the door at the latch side. Where at double doors with one active leaf, the sign shall be located on the inactive leaf. Where at double doors with two active leaves, the sign shall be located to the right of the right hand door. Where there is no wall space at the latch side of the single door or at the right side of double doors, signs shall be located on the nearest adjacent wall. Signs containing tactile characters shall be located so that a clear floor space of 18 inches maximum by 18 inches minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position. (11B-703.4)
- G. Raised and visual character proportions: Characters shall be selected from fonts where the width of the uppercase letter "O" is 60 percent minimum and 110 percent maximum of the height of the uppercase "I". (11B-703.2 and 11B-703.5)
- H. Raised and visual character format: Text shall be in a horizontal format. (11B-703.2 and 11B-703.5)
- I. Visual character and line spacing: Visual character spacing on sign shall be measured between the two closest points of adjacent characters, excluding word spaces. Spacing between individual characters shall be 10 percent minimum and 35 percent maximum of character height. Spacing between the baselines of separate lines of characters within a message shall be 135 percent minimum and 170 percent maximum of the character height. (11B-703.5)
- J. Visual character height and installation height: Minimum character height shall comply with Table 11B-703.5.k below. Viewing distance shall be measured as the horizontal distance between the character and an obstruction preventing further approach towards the sign. Character height shall be based on the uppercase letter "I". Visual characters shall be installed at 40 inches minimum above the finish floor or ground except for the elevator car controls, floor-level exit signs and emergency procedures information. (11B-703.5)

HEIGHT TO FINISH FLOOR OR GROUND FROM BASELINE OF CHARACTER	HORIZONTAL VIEWING DISTANCE	MINIMUM CHARACTER HEIGHT
40 inches to less than or equal to 70 inches	less than 72 inches	5/8 inch
	72 inches and greater	5/8 inch, plus 1/8 inch per foot of viewing distance above 72 inches
greater than 70 inches to less than or equal to 120 inches	less than 180 inches	2 inches
	180 inches and greater	2 inches, plus 1/8 inch per foot of viewing distance above 180 inches
greater than 120 inches	less than 21 feet	3 inches
	21 feet and greater	3 inches, plus 1/8 inch per foot of viewing distance above 21 feet

- K. Visual character case and style: Visual characters on sign shall be uppercase or lowercase or a combination of both and conventional in form. Characters shall not be italic, oblique, script, highly decorative, or of other unusual forms. (11B-703.5)
- L. Visual character stroke thickness: Stroke thickness of the uppercase letter "I" shall be 10 percent maximum of the height of the character. (11B-703.5)
- M. Visual character pictogram finish and contrast: Visual characters and their background, and pictograms and their fields sign shall have a non-glare finish. Characters shall contrast with their background; and pictograms shall contrast with their field. (11B-703.5 and 11B-703.5)
- N. Pictogram field and text descriptors: Pictograms shall have a field height of 6 inches minimum; characters and Braille shall not be located in the pictogram field. Text descriptions shall be located directly below the pictogram field; and shall comply with the requirements for raised characters and Braille. (11B-703.6)

2.2 MANUFACTURERS

- A. Interior Flat Signs:
 - 1. Best Sign Systems, Inc: www.bestsigns.com.
 - 2. Mohawk Sign Systems, Inc: www.mohawksign.com.
 - 3. Seton Identification Products: www.seton.com/aec.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Cast Metal Letters:
 - 1. Metal Arts, www.metalarts.com.
 - 2. Or equal.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.

2.3 INTERIOR SIGNS

- A. See drawing sheet 11.01 and 11.02 for additional requirements.
- B. ADA-Compliant Interior and Exterior Signage, Borderless:
 - 1. See drawings for overall requirements for size, style, layout, and braille requirements.
 - 2. Sign Thickness: 1/4 inch thick or 1/2 inch thick as indicated on drawings.
 - 3. Construction: One-piece and two-piece with inserts; added-on or engraved characters not acceptable.
 - 4. Lettering Style: Avenir by Adobe.
 - 5. Braille: California contracted Grade 2 Braille, placed directly below last line of letters or numbers.
 - 6. Performance: Non-static, fire-retardant, and self-extinguishing.
 - 7. Contrast: Letters numbers and symbols shall contrast with background.
 - 8. Corners: Square and round as drawn.
 - 9. Color of Plastic: As selected from manufacturer's standard colors.
 - 10. Finish of Plastic: Matte.

11. Color of Background: As selected from manufacturer's standard paint colors.
 12. Letter and Number Sizes: See drawings.
 13. Sign Margins: Letters and numbers, 1/2 inch left margin and 3/8 inch top margin.
 14. Sign Sizes: See drawings.
- C. Fire Evacuation, Area of Rescue Assistance and Specialty Signs:
1. Style: Fire Evacuation and Area of Rescue Assistance Signs by Best Sign Systems.
 2. Emergency Exit Only Signs: 18-1/2 by 6-1/2 inches 'MP' plastic with copy raised with background and symbol painted 2 standard paint colors.
 3. Lettering Style: Typeface as selected, upper case.
 4. Letter and Number Size: As selected.
 5. Lettering Location: Centered on sign..
 6. Symbol Height: As selected.
 7. Braille: Grade 2 Braille, placed directly below last line of letters or numbers.
 8. Corners: Square.
- D. Nonilluminated Message-Strip Directories: Extruded-aluminum profiled frame at top and bottom, with sheet metal rear cover, housing changeable message strips in configuration indicated.
1. Frame:
 - a. Top and Bottom Profile: Square.
 - b. Side Trim: Aluminum angle.
 - c. Depth: Manufacturer's standard 1-1/2- to 2-1/2-inch (38- to 64-mm) frame depth.
 - d. Profile Face Dimension: 6 inches (152 mm) high.
 - e. Aluminum Finish: Clear anodic.
 - f. Cover: Removable, clear acrylic sheet held in place by perimeter frame. Provide suction cup tool for cover removal.
 - g. Number of Columns: As indicated on Drawings.
 - h. Mounting: Surface.
 - i. Header: Copy applied to top section of profiled frame.
 - j. Divider Color: As indicated on Drawings.

2.4 DIMENSIONAL CHARACTERS

- A. Cast Metal Characters:
1. Style: Floating.
 2. Height: 9 inches.
 3. Finish: Brushed Aluminum.
 4. Mounting: Pin mounted.
 5. Provide UL Listed LED backlighting at exterior cast metal letters.
- B. Field-Applied, Vinyl-Character Signs
1. Prespaced characters die cut from 3- to 3.5-mil (0.076- to 0.089-mm) thick, weather-resistant vinyl film with release liner on the back and carrier film on the front for on-site alignment and application.
 2. Substrate: Glass

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine installation areas to ensure that conditions are suitable for installation.
- B. Examine signage for defects prior to installation. Do not install damaged signage.

3.2 PREPARATION

- A. Verify mounting heights and locations for interior signage will comply with referenced standards.
- B. Clean mounting locations of dirt, dust, grease or similar conditions that would prevent proper installation.

3.3 INSTALLATION

- A. Install signs level, plumb, without distortion, and in proper relationship with adjacent surfaces using manufacturer's recommended standard mounting system.
 - 1. Mounting: Mount with vinyl foam tape where possible.
 - a. Where exposed fasteners are required, use stainless steel or painted to match sign.
- B. Remove adhesive from exposed sign surfaces as recommended by manufacturer.
- C. Clean signs after installation as recommended by manufacturer.
- D. Replace damaged products before Substantial Completion.

END OF SECTION

SECTION 12 24 13

ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes roller shades.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.
- B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.
- C. Samples for Initial Selection: For each colored component of each type of shade indicated.
 - 1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification:
 - 1. Complete, full-size operating unit not less than 16 inches wide for each type of roller shade indicated.
 - 2. For the following products:
 - a. Shade Material: Not less than 3 inches square, with specified treatments applied. Mark face of material.
 - b. Valance: Full-size unit, not less than 12 inches long.
- E. Window Treatment Schedule: For roller shades. Use same designations indicated on Drawings.
- F. Product Certificates: For each type of roller shade, signed by product manufacturer.
- G. Qualification Data: For Installer.
- H. Product Test Reports: For each type of roller shade.

- I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of roller shade.
- J. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining roller shades and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
 - 3. Operating hardware.

1.4 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. 2016 Building Standards Administrative Code, Part 1, CBSC.
 - 2. 2010 California Building Code (CBC), Part 2, CBSC (2015 IBC & 2016 California Amendments).
 - 3. 2016 California Electrical Code (CEC), Part 3, CBSC (2014 National Electrical Code & 2016 California Amendments).
 - 4. 2016 California Mechanical Code (CMC), Part 4, CBSC (2015 Uniform Mechanical Code & 2016 California Amendments).
 - 5. 2016 California Plumbing Code (CPC), Part 5, CBSC (2015 Uniform Plumbing Code & 2016 California Amendments).
 - 6. 2016 California Energy Code, Part 6, CBSC.
 - 7. 2016 California Historical Building Code, Part 8, CBSC.
 - 8. 2016 California Fire Code, Part 9, CBSC (2015 International Fire Code & 2016 California Amendments).
 - 9. 2016 California referenced Standards, Part 12 CBSC.
 - 10. Title 8 C.C.R. Chapter 4, Sub-Ch. 6 – Elevator Safety Orders.
 - 11. Title 19 C.C.R., Public Safety, SFM Regulations.
 - 12. Americans with Disabilities Act (ADA), Title II or Title III.
- B. Installer Qualifications: Fabricator of products.
- C. Source Limitations: Obtain roller shades through one source from a single manufacturer.
- D. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and listing approved by CSFM.
 - 1. Flame-Resistance Ratings: Passes NFPA 701.
- E. Product Standard: Provide roller shades complying with WCMA A 100.1.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of roller shades that fails in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 1 year.
- B. Installer's Warranty: 1 year.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Rollers Shades: Before installation begins, for each size, color, texture, and pattern indicated, full-size units equal to 5 percent of amount installed, but not fewer than 2 units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Roller Shades: Subject to compliance with requirements, provide either the named product or an equal product by one of the other manufacturers specified.
 - 1. Slim Line by MechoShade Systems, Inc. 42-03 35th Street, Long Island City, NY 11101. ASD. Tel: Contact Sonny Flink, phone 818-346-0308 (Basis of Design)
 - 2. Draper Inc.
 - 3. Silent Gliss USA, Inc.
 - 4. Or equal.

2.2 ROLLER SHADES

- A. Type: Manually operated shades:

- B. Mounting: Surface mounted.
- C. Configuration: Single solar shade cloth.
- D. Solar Shade cloth:
 - 1. ThermoVeil 1000 Series Dense Vertical Weave, Group A.
 - 2. 1000 Series Dense Vertical Weave ShadeCloths are technically advanced lineally woven shade cloths with a 2-3% openness factor. Washable, flame retardant and fade resistant. ThermoVeil Vertical Weaves are offered and available in a wide range of colors. They contribute towards a healing environment by helping patients take advantage of the therapeutic natural lights and views.
 - 3. Content: 79% vinyl, 21% polyester core.
 - 4. Openness Factor: $\pm 2-3\%$
 - 5. Stocked in 72" and 96" widths.
 - 6. Color: Selected from manufacturer's standard colors.

2.3 ACCESSORIES

- A. Roller Shade Pocket: For recessed mounting in acoustical tile, or drywall ceilings as indicated on the Drawings.
 - 1. Product: 1-1/2" by 6" clean anodized aluminum.
 - 2. Provide either extruded aluminum and or formed steel shade pocket, sized to accommodate roller shades, with exposed extruded aluminum closure mount, tile support and removable closure panel to provide access to shades.
 - a. Provide "Vented Pocket" such that there will be a minimum of four 1 inch diameter holes per foot allowing the solar gain to flow above the ceiling line.
 - 3. Pocket Accessories: As indicated on the Drawings.
- B. Room Darkening Side Channels (For shades mounted to doors)
 - 1. Extruded aluminum with polybond edge seals and SnapLoc-mounting brackets and with concealed fastening. Exposed fastening is not acceptable. Channels shall accept one-piece exposed blackout hembar with vinyl seal to assure side light control.
 - a. Side channels, 1-15/16 inches wide by 1-3/16 inches deep, two-band center channels, 2-5/8 inches wide by 1-3/16 inches deep.
- C. Fascia:
 - 1. Continuous removable extruded aluminum fascia that attaches to shade mounting brackets without the use of adhesives, magnetic strips, or exposed fasteners.
 - 2. Fascia shall be able to be installed across two or more shade bands in one piece.
 - 3. Fascia shall fully conceal brackets, shade roller and fabric on the tube.
 - 4. Provide bracket / fascia end caps where mounting conditions expose outside of roller shade brackets.
 - 5. Notching of Fascia for manual chain shall not be acceptable.

2.4 SHADE BAND

- A. Shade Bands: Construction of shade band includes the fabric, the hem weight, hem-pocket, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems and open hem pockets are not acceptable.
 - 1. Hem Pockets and Hem Weights: Fabric hem pocket with RF-welded seams (including welded ends) and concealed hem weights. Hem weights shall be of appropriate size and weight for shade band. Hem weight shall be continuous inside a sealed hem pocket. Hem pocket construction and hem weights shall be similar, for all shades within one room.
 - 2. Shade Band and Shade Roller Attachment:
 - a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection. Roller tubes less than 1.55 inch in diameter for manual shades, and less than 2.55 inches for motorize shades are not acceptable.
 - b. Provide for positive mechanical engagement with drive / brake mechanism.
 - c. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with a "snap-on" snap-off" spline mounting, without having to remove shade roller from shade brackets.
 - d. Mounting spline shall not require use of adhesives, adhesive tapes, staples, and/or rivets.
 - e. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets are not acceptable.

2.5 SHADE FABRICATION

- A. Fabricate units to completely fill existing openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise.
- B. Fabricate shadecloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate unguided shadecloth to roll true and straight without shifting sideways more than 1/8 inch in either direction per 8 feet of shade height due to warp distortion or weave design. Fabricate hem as follows:
 - 1. Standard concealed hem bar.

2.6 COMPONENTS

- A. Access and Material Requirements:
 - 1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening and without requiring end or center supports to be removed.
 - 2. Provide shade hardware that allows for removal and re-mounting of the shade bands without having to remove the shade tube, drive or operating support brackets.
 - 3. Use only Delrin engineered plastics by DuPont for all plastic components of shade hardware. Styrene based plastics, and /or polyester, or reinforced polyester will not be acceptable.

B. Manual Operated Chain Drive Hardware and Brackets:

1. Provide for universal, regular and offset drive capacity, allowing drive chain to fall at front, rear or non-offset for all shade drive end brackets. Universal offset shall be adjustable for future change.
2. Provide hardware capable for installation of a removable fascia, for both regular and/or reverse roll, which shall be installed without exposed fastening devices of any kind.
3. Provide shade hardware system that allows for removable regular and/or reverse roll fascias to be mounted continuously across two or more shade bands without requiring exposed fasteners of any kind.
4. Provide shade hardware system that allows for operation of multiple shade bands (multi-banded shades) by a single chain operator, subject to manufacturer's design criteria. Connectors shall be offset to assure alignment from the first to the last shade band.
5. Provide shade hardware system that allows multi-banded manually operated shades to be capable of smooth operation when the axis is offset a maximum of 6 degrees on each side of the plane perpendicular to the radial line of the curve, for a 12 degrees total offset.
6. Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connectors for drive mechanism connection to shade roller tube are not acceptable
7. Provide shade hardware constructed of minimum 1/8-inch thick plated steel or heavier as required to support 150 percent of the full weight of each shade.
8. Drive Bracket / Brake Assembly:
 - a. MechoShade Drive Bracket model shall be fully integrated with all MechoShade accessories, including, but not limited to: SnapLoc fascia, room darkening side / sill channels, center supports and connectors for multi-banded shades.
 - b. M5 drive sprocket and brake assembly shall rotate and be supported on a welded 3/8 inch steel pin.
 - c. The brake shall be an over-running clutch design which disengages to 90 percent during the raising and lowering of a shade. The brake shall withstand a pull force of 50 lbs. in the stopped position.
 - d. The braking mechanism shall be applied to an oil-impregnated hub on to which the brake system is mounted. The oil impregnated hub design includes an articulated brake assembly, which assures a smooth, non-jerky operation in raising and lowering the shades. The assembly shall be permanently lubricated. Products that require externally applied lubrication and or not permanently lubricated are not acceptable.
 - e. The entire M5 assembly shall be fully mounted on the steel support bracket, and fully independent of the shade tube assembly, which may be removed and reinstalled without effecting the roller shade limit adjustments.
 - f. Drive Chain: #10 qualified stainless steel chain rated to 90 lb. minimum breaking strength. Nickel plate chain shall not be accepted.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION

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SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Rubber union connector packless expansion joints.
 - 2. Flexible-hose packless expansion joints.
 - 3. Metal-bellows packless expansion joints.
 - 4. Externally pressurized metal-bellows packless expansion joints.
 - 5. Rubber packless expansion joints.
 - 6. Grooved-joint expansion joints.
 - 7. Alignment guides and anchors.
 - 8. Pipe loops and swing connections.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.6 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.2 PACKLESS EXPANSION JOINTS

- A. Rubber Union Connector Expansion Joints RUEJ-01:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Mason Industries, Inc.
 - d. Unisource Manufacturing, Inc.
 - 2. Material: Twin reinforced-rubber spheres with external restraining cables.
 - 3. Minimum Pressure Rating: 150 psig at 170 deg F, unless otherwise indicated.
 - 4. End Connections for NPS 2 and Smaller: Threaded.
- B. Flexible-Hose Packless Expansion Joints FHEJ-01:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Mason Industries, Inc.
 - d. Metraflex Company (The).
 - 2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
 - 3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
 - 4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.

- a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
 - b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.
 5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.
 6. Expansion Joints for Steel Piping NPS 2 and Smaller: Carbon-steel fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.
 7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with flanged or welded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.
 8. Expansion Joints for Steel Piping NPS 8 to NPS 12: Carbon-steel fittings with flanged or welded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F and 90 psig at 600 deg F ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.
 9. Expansion Joints for Steel Piping NPS 14 and Larger: Carbon-steel fittings with flanged or welded end connections.
 - a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.
- C. Metal-Bellows Packless Expansion Joints MBEJ-01:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Expansion Joint Systems, Inc.
 - b. Flex-Hose Co., Inc.
 - c. Flexicraft Industries.
 - d. Mason Industries, Inc.
 - e. Metraflex Company (The).
 2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
 3. Type: Circular, corrugated bellows with external tie rods.
 4. Minimum Pressure Rating: 150 psig to 200 psig, unless otherwise indicated.
 5. Configuration: Single joint with base or double joint with base class(es), unless otherwise indicated.

6. Expansion Joints for Copper Tubing: Single- or multi- ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
 - a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
 - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint or threaded.
 - c. End Connections for Copper Tubing NPS 5 and Larger: Flanged.
 7. Expansion Joints for Steel Piping: Single- or multi- ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.
 - a. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
 - b. End Connections for Steel Pipe NPS 2-1/2 and Larger: Flanged or Welded.
- D. Externally Pressurized Metal-Bellows Packless Expansion Joints EPEJ-01:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flex-Hose Co., Inc.
 - b. Mason Industries, Inc.
 - c. Metraflex Company (The).
 - d. U.S. Bellows, Inc.
 2. Minimum Pressure Rating: 150 psig, unless otherwise indicated.
 3. Description:
 - a. Totally enclosed, externally pressurized, multi-ply, stainless-steel bellows isolated from fluid flow by an internal pipe sleeve.
 - b. Carbon-steel housing.
 - c. Drain plugs and lifting lug for NPS 3 and larger.
 - d. Bellows shall have operating clearance between the internal pipe sleeves and the external shrouds.
 - e. Joints shall be supplied with a built-in scale to confirm the starting position and operating movement.
 - f. Joint Axial Movement: 4 inches, 6 inches, 8 inches of compression and 0.75 inch, 1 inch, 2 inches of extension as required.
 4. Permanent Locking Bolts: Set locking bolts to maintain joint lengths during installation. Temporary welding tabs that are removed after installation in lieu of locking bolts are not acceptable.
 5. End Connection Configuration: Flanged; one raised, fixed and one floating flange.
- E. Rubber Packless Expansion Joints REJ-01:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Flex-Hose Co., Inc.
 - b. Mason Industries, Inc.
 - c. Metraflex Company (The).
 - d. Unaflex.
 2. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
 3. Material: Fabric-reinforced rubber complying with FSA-PSJ-703.
 4. Arch Type: Single or multiple arches with external control rods.
 5. Spherical Type: Single or multiple spheres with external control rods.
 6. Minimum Pressure Rating for NPS 1-1/2 to NPS 4: 150 psig at 220 deg F.
 7. Minimum Pressure Rating for NPS 5 and NPS 6: 140 psig at 200 deg F.

8. Minimum Pressure Rating for NPS 8 to NPS 12: 140 psig at 180 deg F.
9. Material for Fluids Containing Acids, Alkalis, or Chemicals: Butyl rubber, Chlorosulfonyl-polyethylene rubber or Ethylene-propylene-diene terpolymer rubber.
10. Material for Fluids Containing Gas, Hydrocarbons, or Oil: Buna-N or Chlorosulfonated polyethylene synthetic rubber.
11. Material for Water: Butyl rubber, Buna-N, Chlorosulfonated polyethylene synthetic rubber, Chlorosulfonyl-polyethylene rubber, Ethylene-propylene-diene terpolymer rubber or Natural rubber.
12. End Connections: Full-faced, integral steel flanges with steel retaining rings.

2.3 GROOVED-JOINT EXPANSION JOINTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Anvil International.
 2. Shurjoint Piping Products USA Inc.
 3. Victaulic Company.
- B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.
- C. Standard: AWWA C606, for grooved joints.
- D. Nipples: Galvanized, ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.
- E. Couplings: Five to twelve, flexible type for steel-pipe dimensions. Include ferrous housing sections, Buna-N gasket suitable for diluted acid, alkaline fluids, and cold and hot water, Ethylene-propylene-diene terpolymer rubber gasket suitable for cold and hot water, and bolts and nuts.

2.4 ALIGNMENT GUIDES AND ANCHORS

- A. Alignment Guides AG-01:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Flex-Hose Co., Inc.
 - b. Flexicraft Industries.
 - c. Flex-Weld, Inc.
 - d. Mason Industries, Inc.
 - e. U.S. Bellows, Inc.
 2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.
- B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.
 - b. Expansion Plug: Zinc-coated steel.
 - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
 - c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION JOINT INSTALLATION

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- C. Install rubber packless expansion joints according to FSA-PSJ-703.
- D. Install grooved-joint expansion joints to grooved-end steel piping.

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one or two guides on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe, and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
 - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 220516

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SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Sleeve-seal fittings.
 - 5. Grout.
 - 6. Silicone sealants.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. GPT; an EnPro Industries company.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.

- D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- E. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.
- F. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- G. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Jay R. Smith Mfg. Co.
 - 2. Zurn Industries, LLC.
- B. Description: Manufactured, Dura-coated or Duco-coated cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Proco Products, Inc.
- B. Description:
 - 1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 2. Designed to form a hydrostatic seal of 20 psig minimum.
 - 3. Sealing Elements: EPDM-rubber, High-temperature-silicone or Nitrile Buna N interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 4. Pressure Plates: Carbon steel, Stainless steel, Type 316.
 - 5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B 633, Stainless steel, Type 316 of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

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

2. CALPICO, Inc.
3. Proco Products, Inc.

- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.
- C. Plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.6 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Dow Corning Corporation.
 - b. Polymeric Systems, Inc.
 - c. Sherwin-Williams Company (The).
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. May National Associates, Inc.; a subsidiary of Sika Corporation.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Smooth-On.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout or silicone sealant, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."
- F. Sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
 - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Use silicone sealant to seal the space around outside of stack-sleeve fittings.

- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Use grout or silicone sealant to seal the space around outside of sleeve-seal fittings.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves, Steel pipe sleeves or Sleeve-seal fittings.
 - b. Piping NPS 6 and Larger: Cast-iron pipe sleeves, Steel pipe sleeves or Sleeve-seal fittings.
 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system, Steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system, Steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system, Steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system, Steel pipe sleeves with sleeve-seal system or Sleeve-seal fittings.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: Steel pipe sleeves, PVC pipe sleeves, Stack-sleeve fittings, Sleeve-seal fittings, Molded-PE or -PP sleeves or Molded-PVC sleeves.
 - b. Piping NPS 6 and Larger: Steel pipe sleeves, PVC pipe sleeves or Stack-sleeve fittings.
 5. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Steel pipe sleeves or PVC pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.3 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. BrassCraft Manufacturing Co.; a Masco company.
 - 2. Dearborn Brass.
 - 3. Keeney Manufacturing Company (The).
 - 4. ProFlo; a Ferguson Enterprises, Inc. brand.

2.2 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

- C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel or brass with polished, chrome-plated finish and spring-clip fasteners.
- E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed or exposed-rivet hinge; and spring-clip fasteners.

2.3 FLOOR PLATES

- A. Split Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping and Relocated Existing Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
 - b. Chrome-Plated Piping: One-piece steel or split-casting brass with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
 - d. Insulated Piping: One-piece stainless steel with polished stainless-steel finish.
 - e. Insulated Piping: One-piece cast brass with polished, chrome-plated finish.
 - f. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - g. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
 - h. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
 - i. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
 - j. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - k. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
 - l. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
 - m. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.

- n. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - o. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
 - p. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated finish.
 - q. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - r. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.
 - s. Bare Piping in Equipment Rooms: One-piece cast brass with polished, chrome-plated finish.
 - t. Bare Piping in Equipment Rooms: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - 2. Escutcheons for Existing Piping to Remain:
 - a. Chrome-Plated Piping: Split-casting, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
 - f. Bare Piping in Equipment Rooms: Split-plate, stamped steel with concealed or exposed-rivet hinge with polished, chrome-plated finish.
 - C. Install floor plates for piping penetrations of equipment-room floors.
 - D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. New Piping and Relocated Existing Piping: One-piece, floor plate.
 - 2. Existing Piping: Split floor plate.
- 3.2 FIELD QUALITY CONTROL
- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 220518

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SECTION 220523 - GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.
 - 3. Bronze lift check valves.
 - 4. Bronze swing check valves.
 - 5. Bronze gate valves.
 - 6. Iron, single-flange butterfly valves.
 - 7. Iron, grooved-end butterfly valves.
 - 8. Chainwheels.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve.
 - 1. Certification that products comply with NSF 61 and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
 2. Protect threads, flange faces, and soldered ends.
 3. Protect threads, flange faces, grooves, and weld ends.
 4. Set ball valves open to minimize exposure of functional surfaces.
 5. Set check valves in either closed or open position.
 6. Set gate valves closed to prevent rattling.
 7. Set butterfly valves closed or slightly open.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded end valves.
 2. ASME B16.1 for flanges on iron valves.
 3. ASME B16.5 for flanges on steel valves.
 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 5. ASME B16.18 for solder-joint connections.
 6. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.
- E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- G. RS Valves in Insulated Piping: With 2-inch stem extensions.
- H. Valve Sizes: Same as upstream piping unless otherwise indicated.
- I. Valve Bypass and Drain Connections: MSS SP-45.

- J. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handlever: For quarter-turn valves smaller than NPS 6.
 - 3. Chainwheel: Device for attachment to gear, handlever, or stem; of size and with chain for mounting height, according to "Valve Installation" Article.
- K. Valves in Insulated Piping:
 - 1. Include 2-inch stem extensions.
 - 2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
 - 3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRASS BALL VALVES

- A. Brass Ball Valves, One-Piece:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. KITZ Corporation.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig.
 - c. Body Design: One piece.
 - d. Body Material: Forged brass or bronze.
 - e. Ends: Threaded and soldered.
 - f. Seats: PTFE.
 - g. Stem: Brass or stainless steel.
 - h. Ball: Chrome-plated brass or stainless steel.
 - i. Port: Reduced.
- B. Brass Ball Valves, Two-Piece with Full Port and Brass Trim, Threaded or Soldered Ends:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. FNW; Ferguson Enterprises, Inc.
 - c. KITZ Corporation.
 - d. NIBCO INC.
 - e. Red White Valve Corp.
 - 2. Description:
 - a. Standard: MSS SP-110 or MSS SP-145.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded and soldered.
 - f. Seats: PTFE.
 - g. Stem: Brass.
 - h. Ball: Chrome-plated brass.

- i. Port: Full.
- C. Brass Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim, Threaded or Soldered Ends:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. KITZ Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110 or MSS SP-145.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded and soldered.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Full.
- D. Brass Ball Valves, Two-Piece with Regular Port and Brass Trim:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. FNW; Ferguson Enterprises, Inc.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded and soldered.
 - f. Seats: PTFE.
 - g. Stem: Brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Regular.
- E. Brass Ball Valves, Two-Piece with Regular Port and Stainless-Steel Trim:
- 1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Brass or bronze.
 - e. Ends: Threaded and soldered.

- f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Regular.
- F. Brass Ball Valves, Three-Piece with Full Port and Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jomar Valve.
 - b. KITZ Corporation.
 - c. WATTS.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Three piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded and soldered.
 - f. Seats: PTFE.
 - g. Stem: Brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.
- G. Brass Ball Valves, Three-Piece with Full Port and Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Marwin Valve; Richards Industries.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Three piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded and soldered.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Full.

2.3 BRONZE BALL VALVES

- A. Bronze Ball Valves, One-Piece with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. FNW; Ferguson Enterprises, Inc.
 - c. NIBCO INC.

- d. WATTS.
- 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig.
 - c. Body Design: One piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE.
 - g. Stem: Bronze.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.
- B. Bronze Ball Valves, One-Piece with Stainless-Steel Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. NIBCO INC.
 - c. WATTS.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: One piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Reduced.
- C. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Threaded or Soldered Ends:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. FNW; Ferguson Enterprises, Inc.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110 or MSS-145.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded and soldered.
 - f. Seats: PTFE.
 - g. Stem: Bronze or brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.

- D. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim, Press Ends:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. WATTS.
 2. Description:
 - a. Standard: MSS SP-110 or MSS-145.
 - b. CWP Rating: Minimum 200 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Press.
 - f. Press Ends Connections Rating: Minimum 200 psig.
 - g. Seats: PTFE or RTPFE.
 - h. Stem: Bronze or brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.
 - k. O-Ring Seal: EPDM or Buna-N.
- E. Bronze Ball Valves, Two-Piece with Full Port and Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. FNW; Ferguson Enterprises, Inc.
 - c. NIBCO INC.
 - d. WATTS.
 2. Description:
 - a. Standard: MSS SP-110 or MSS-145.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded or soldered.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Full.
- F. Bronze Ball Valves, Two-Piece with Regular Port and Bronze or Brass Trim:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. WATTS.
 2. Description:

- a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE.
 - g. Stem: Bronze or brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Regular.
- G. Bronze Ball Valves, Two-Piece with Regular Port and Stainless-Steel Trim:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Hammond Valve.
 - c. NIBCO INC.
 - d. WATTS.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Regular.
- H. Bronze Ball Valves, Three-Piece with Full Port and Bronze or Brass Trim:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. WATTS.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Three piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE.
 - g. Stem: Bronze or brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Full.
- I. Bronze Ball Valves, Three-Piece with Full Port and Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. WATTS.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Three piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Full.
- J. Bronze Ball Valves, Three-Piece with Regular Port and Bronze Trim:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Jamesbury; Metso.
 - c. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Three piece
 - d. Body Material: Bronze
 - e. Ends: Threaded or soldered.
 - f. Seats: PTFE.
 - g. Stem: Bronze.
 - h. Ball: Chrome-plated brass.
 - i. Port: Regular.
- K. Bronze Ball Valves, Three-Piece with Regular Port and Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Jamesbury; Metso.
 - c. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Three piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded or soldered.

- f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Stainless steel, vented.
 - i. Port: Regular.
- L. Bronze Ball Valves, Two-Piece, Safety-Exhaust:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Jamesbury; Metso.
 - c. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece.
 - d. Body Material: Bronze, ASTM B 584, Alloy C844.
 - e. Ends: Threaded.
 - f. Seats: PTFE.
 - g. Stem: Stainless steel.
 - h. Ball: Chrome-plated brass, with exhaust vent opening for pneumatic applications.
 - i. Port: Full.

2.4 BRONZE LIFT CHECK VALVES

- A. Bronze Lift Check Valves with Bronze Disc, Class 125:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Crane; Crane Energy Flow Solutions.
 - b. Jenkins Valves; Crane Energy Flow Solutions.
 - c. Stockham; Crane Energy Flow Solutions.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded or soldered. See valve schedule articles.
 - f. Disc: Bronze.
- B. Bronze Lift Check Valves with Nonmetallic Disc, Class 125:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. KITZ Corporation.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. WATTS.

2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded or soldered. See valve schedule articles.
 - f. Disc: NBR, PTFE.

2.5 BRONZE SWING CHECK VALVES

- A. Bronze Swing Check Valves with Bronze Disc, Class 125:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. KITZ Corporation.
 - c. NIBCO INC.
 - d. Stockham; Crane Energy Flow Solutions.
 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded or soldered. See valve schedule articles.
 - f. Disc: Bronze.
- B. Bronze Swing Check Valves with Nonmetallic Disc, Class 125:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Crane; Crane Energy Flow Solutions.
 - c. KITZ Corporation.
 - d. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded or soldered. See valve schedule articles.
 - f. Disc: PTFE.
- C. Bronze Swing Check Valves with Bronze Disc, Class 150:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Crane; Crane Energy Flow Solutions.

- c. KITZ Corporation.
- d. NIBCO INC.
- 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded or soldered. See valve schedule articles.
 - f. Disc: Bronze.

D. Bronze Swing Check Valves with Nonmetallic Disc, Class 150:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Crane; Crane Energy Flow Solutions.
 - b. FNW; Ferguson Enterprises, Inc.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
- 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded or soldered. See valve schedule articles.
 - f. Disc: PTFE.

2.6 BRONZE GATE VALVES

A. Bronze Gate Valves, NRS, Class 125:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. FNW; Ferguson Enterprises, Inc.
 - c. KITZ Corporation.
 - d. NIBCO INC.
- 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: Bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

B. Bronze Gate Valves, RS, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. FNW; Ferguson Enterprises, Inc.
 - c. KITZ Corporation.
 - d. NIBCO INC.
 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Material: Bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.
- C. Bronze Gate Valves, NRS, Class 150:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. KITZ Corporation.
 - c. NIBCO INC.
 - d. WATTS.
 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - c. Body Material: Bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.
- D. Bronze Gate Valves, RS, Class 150:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. KITZ Corporation.
 - c. NIBCO INC.
 - d. WATTS.
 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: Bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.

- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

2.7 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. Iron, Single-Flange Butterfly Valves with Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. KITZ Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM or NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.

B. Iron, Single-Flange Butterfly Valves with Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. KITZ Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM or NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nickel-plated or nickel-coated ductile iron.

C. Iron, Single-Flange Butterfly Valves with Stainless-Steel Disc:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Apollo Flow Controls; Conbraco Industries, Inc.
- b. KITZ Corporation.
- c. Milwaukee Valve Company.
- d. NIBCO INC.
3. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating, NPS 12 and Smaller: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM or NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Stainless steel.

2.8 DUCTILE-IRON, GROOVED-END BUTTERFLY VALVES

- A. Ductile Iron, Grooved-End Butterfly Valves, 175 CWP:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Kennedy Valve Company; a division of McWane, Inc.
 - b. Tyco Fire Products LP.
 - c. Victaulic Company.
 - d. Zurn Industries, LLC.
 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 175 psig.
 - c. Body Material: Coated, ductile iron.
 - d. Stem: Two-piece stainless steel.
 - e. Disc: Coated, ductile iron.
 - f. Seal: EPDM.
- B. Ductile Iron, Grooved-End Butterfly Valves, 300 CWP:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Mueller Steam Specialty; A WATTS Brand.
 - b. NIBCO INC.
 - c. Tyco Fire Products LP.
 - d. Victaulic Company.
 2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating, NPS 8 and Smaller: 300 psig.
 - c. CWP Rating, NPS 10 and Larger: 200 psig.
 - d. Body Material: Coated, ductile iron.
 - e. Stem: Two-piece stainless steel.

- f. Disc: Coated, ductile iron.
- g. Seal: EPDM or NBR.

2.9 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Babbitt Steam Specialty Co.
 - 2. Roto Hammer Industries.
 - 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to handwheels.
 - 1. Sprocket Rim with Chain Guides: Ductile or cast iron, Aluminum or Bronze, of type and size required for valve. Include zinc or epoxy coating.
 - 2. Chain: Hot-dip, galvanized steel, Brass or Stainless steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.

- D. Install valves in position to allow full stem movement.
- E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- F. Check Valves: Install check valves for proper direction of flow.
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.
- G. Install chainwheels on operators for gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

3.3 ADJUSTING

- 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.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If ball valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Grooved-End Copper Tubing and Steel Piping: Grooved.
- C. If check valve applications are not indicated, use the following:
 - 1. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or spring; or iron, center-guided, metal-seat or resilient-seat check valves.
 - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- D. Use gate valves for shutoff service only.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Brass ball valve, one piece. Provide with threaded or solder-joint ends.

2. Bronze ball valve, one piece with bronze or stainless steel trim. Provide with threaded or solder-joint ends.
3. Brass ball valves, two-piece with full-port and brass or stainless steel trim. Provide with threaded or solder-joint ends.
4. Bronze ball valves, two-piece with full-port and bronze, brass or stainless steel trim. Provide with threaded or solder-joint ends.
5. Brass ball valves, three-piece with full port and brass or stainless steel trim.
6. Bronze ball valves, three-piece with full port and bronze, brass or stainless steel trim.
7. Bronze ball valves, two-piece with regular port and bronze or stainless-steel trim.
8. Bronze swing check valves with bronze disc, Class 125 or Class 150, with soldered or threaded end connections.
9. Bronze gate valves, NRS, RS, Class 125 or Class 150 with soldered or threaded ends.

B. Pipe NPS 2-1/2 and Larger:

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Steel ball valves, Class 150 with full-port.
3. Iron ball valves, Class 150.
4. Iron swing check valves with metal seats, Class 125 or Class 250, with threaded or flanged end connections.
5. Iron swing check valves with closure control lever and spring or weight, Class 125, with threaded or flanged end connections.
6. Iron, grooved-end swing check valves, 300 CWP.
7. Iron, center-guided check valves with compact wafer, Class 125, Class 150, Class 250 or Class 300.
8. Iron, center-guided check valves with globe, metal, resilient seat, Class 125, Class 150, Class 250 or Class 300, with threaded or flanged end connections.
9. Iron, dual-plate check valves with metal, resilient seat, Class 125, Class 150, Class 250 or Class 300, with threaded or flanged end connections.
10. Iron, single-plate check valves with resilient seat, Class 125 or Class 250, with threaded or flanged end connections.
11. Iron gate valves, NRS, OS&Y, Class 125 or Class 250 with flanged ends.
12. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM or NBR seat, aluminum-bronze, ductile-iron or stainless-steel disc.
13. Ductile-Iron, Grooved-End Butterfly Valves: 175 or 300 CWP.

END OF SECTION 220523

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.
 - 6. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Craftmark Pipe Markers.

- c. Kolbi Pipe Marker Co.
 - d. Seton Identification Products.
 2. Material and Thickness: Brass, 0.032-inch, stainless steel, 0.025-inch, aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 3. Letter Color: White.
 4. Background Color: Black.
 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brady Corporation.
 - b. Craftmark Pipe Markers.
 - c. Kolbi Pipe Marker Co.
 - d. Seton Identification Products.
 2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
 3. Letter Color: White.
 4. Background Color: Black.
 5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
 8. Fasteners: Stainless-steel rivets or self-tapping screws.
 9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Brady Corporation.
 - 2. Craftmark Pipe Markers.
 - 3. Marking Sevicees Inc.
 - 4. Seton Identification Products.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- C. Letter Color: White.
- D. Background Color: Black.
- E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- H. Fasteners: Stainless-steel rivets or self-tapping screws.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Brady Corporation.
 - 2. Craftmark Pipe Markers.
 - 3. Kolbi Pipe Marker Co.
 - 4. Seton Identification Products.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: Size letters according to ASME A13.1 for piping, At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.4 STENCILS

- A. Stencils for Piping:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Brimar Industries, Inc.
 - b. Craftmark Pipe Markers.
 - c. Kolbi Pipe Marker Co.
 - d. Marking Services Inc.
 - 2. Lettering Size: Size letters according to ASME A13.1 for piping, At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
 - 3. Stencil Material: Aluminum, Brass, Fiberboard or metal.
 - 4. Stencil Paint: Exterior, gloss, alkyd enamel or acrylic enamel paint type in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 5. Identification Paint: Exterior, alkyd enamel or acrylic enamel paint type in colors according to ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.

2.5 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Brady Corporation.
 - 2. Craftmark Pipe Markers.
 - 3. Kolbi Pipe Marker Co.
 - 4. Seton Identification Products.
- B. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch, stainless steel, 0.025-inch, aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link chain or beaded chain.

- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Brady Corporation.
 - 2. Craftmark Pipe Markers.
 - 3. Kolbi Pipe Marker Co.
 - 4. Seton Identification Products.
- B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Safety yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 GENERAL INSTALLATION REQUIREMENTS

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

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.

- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Refer to architectural specifications for the painting of piping.
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe Label Color Schedule:
 - 1. Low-Pressure Compressed Air Piping:
 - a. Background: Safety blue.
 - b. Letter Colors: White.
 - 2. High-Pressure Compressed Air Piping:
 - a. Background: Safety blue.
 - b. Letter Colors: White.
 - 3. Domestic Water Piping
 - a. Background: Safety green.
 - b. Letter Colors: White.
 - 4. Natural Gas Piping
 - a. Background: Safety yellow.
 - b. Letter Colors: Black.
 - 5. Sanitary Waste, Vent and Storm Drainage Piping:
 - a. Background Color: Safety green.
 - b. Letter Color: White.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Domestic Water: 1-1/2 inches or 2 inches, round.
 - b. Natural Gas: 1-1/2 inches or 2 inches, round.
 - c. Low-Pressure Compressed Air: 1-1/2 inches to 2 inches, round.
 - d. High-Pressure Compressed Air: 1-1/2 inches to 2 inches, round.
 - 2. Valve-Tag Colors:
 - a. Domestic Water: Natural.
 - b. Natural Gas: Natural.
 - c. Low-Pressure Compressed Air: Natural.
 - d. High-Pressure Compressed Air: Natural.
 - 3. Letter Colors:
 - a. Domestic Water: Black.
 - b. Natural Gas: Black.
 - c. Low-Pressure Compressed Air: Black.
 - d. High-Pressure Compressed Air: Black.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

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SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
- B. Sustainable Design Submittals:
 - 1. **Product Data:** For adhesives, mastics, and sealants, indicating VOC content.
 - 2. Laboratory Test Reports: For adhesives, mastics, and sealants, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.
- D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
 - 1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
 - 2. Jacket Materials for Pipe: 12 inches long by NPS 2.
 - 3. Sheet Jacket Materials: 12 inches square.

4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
 1. Piping Mockups:
 - a. One 10-foot section of NPS 2 straight pipe.
 - b. One each of a 90-degree threaded, welded, and flanged elbow.
 - c. One each of a threaded, welded, and flanged tee fitting.
 - d. One NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
 - e. Four support hangers including hanger shield and insert.
 - f. One threaded strainer and one flanged strainer with removable portion of insulation.
 - g. One threaded reducer and one welded reducer.
 - h. One pressure temperature tap.
 - i. One mechanical coupling.
 2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.

3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 4. Obtain Architect's approval of mockups before starting insulation application.
 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed.
- D. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 COORDINATION

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

1.8 SCHEDULING

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

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Pittsburgh Corning Corporation.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 5. Preformed Pipe Insulation with Factory-Applied ASJ or ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
 - 6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.
- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. CertainTeed Corporation.
- b. Johns Manville; a Berkshire Hathaway company.
- c. Knauf Insulation.
- d. Manson Insulation Inc.
- e. Owens Corning.

I. Mineral-Fiber, Preformed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. Knauf Insulation.
 - c. Manson Insulation Inc.
 - d. Owens Corning.
2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

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

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

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

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

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

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

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Foster Brand; H. B. Fuller Construction Products.
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. K-Flex USA.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
- E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Dow Corning Corporation.
 - b. Johns Manville; a Berkshire Hathaway company.
 - c. P.I.C. Plastics, Inc.
 - d. Speedline Corporation.

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
 1. Mastics: As recommended by insulation manufacturer and with a VOC content of 50 g/L or less.

2. Mastics shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Knauf Insulation.
 - d. Vimasco Corporation.
 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
 3. Service Temperature Range: 0 to 180 deg F.
 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.

- b. Foster Brand; H. B. Fuller Construction Products.
- c. Knauf Insulation.
- d. Vimasco Corporation.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Foster Brand; H. B. Fuller Construction Products.
 - c. Vimasco Corporation.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 4. Service Temperature Range: 0 to plus 180 deg F.
 5. Color: White.

2.6 SEALANTS

- A. Joint Sealants for Cellular-Glass and Phenolic Products:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Permanently flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 100 to plus 300 deg F.
 5. Color: White or gray.
 6. Sealant shall have a VOC content of 420 g/L or less.
 7. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
 - b. Eagle Bridges - Marathon Industries.
 - c. Foster Brand; H. B. Fuller Construction Products.
 - d. Mon-Eco Industries, Inc.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

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

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Childers Brand; H. B. Fuller Construction Products.
- B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Foster Brand; H. B. Fuller Construction Products.
- b. Vimasco Corporation.

2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Johns Manville; a Berkshire Hathaway company.
 - b. P.I.C. Plastics, Inc.
 - c. Proto Corporation.
 - d. Speedline Corporation.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White or Color-code jackets based on system. Color as selected by Architect when exposed within building.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Pittsburgh Corning Corporation.
 - b. Polyguard Products, Inc.

2.10 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Ideal Tape Co., Inc., an American Biltrite Company.
 - c. Knauf Insulation.
 - d. Venture Tape.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.

4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. Ideal Tape Co., Inc., an American Biltrite Company.
 - c. Knauf Insulation.
 - d. Venture Tape.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Compac Corporation.
 - b. Ideal Tape Co., Inc., an American Biltrite Company.
 - c. Venture Tape.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.

2.11 SECUREMENTS

- A. Bands:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. ITW Insulation Systems; Illinois Tool Works, Inc.
 - b. RPR Products, Inc.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. C & F Wire.

2.12 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Insul-Tect Products Co.
 - b. McGuire Manufacturing.
 - c. Plumberex Specialty Products, Inc.
 - d. Truebro.
 - 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Truebro.
 - b. Zurn Industries, LLC.
 - 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
 - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches to 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."
- 3.5 GENERAL PIPE INSULATION INSTALLATION
- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

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

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install mitered sections of pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.
 - 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - 3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 - 4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 - 1. Install preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.

3.9 INSTALLATION OF PHENOLIC INSULATION

- A. General Installation Requirements:
1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
 2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
- B. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- C. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.10 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

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

C. Insulation Installation on Pipe Fittings and Elbows:

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

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.11 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 - 1. Draw jacket material smooth and tight.
 - 2. Install lap or joint strips with same material as jacket.
 - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
 - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
 - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.12 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Architectural section.
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.
- E. All adhesive shall be as recommended by cellular glass manufacturer and with a VOC content of 80 g/L or less.
- F. Per ASHRAE 189.1, All adhesives and sealants shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

3.14 PIPING INSULATION SCHEDULE, GENERAL

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

3.15 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water (HW Return):
 - 1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - d. Phenolic: 1 inch thick.
 - e. Polyolefin: 1 inch thick.
 - 2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - d. Phenolic: 1 inch thick.
 - e. Polyolefin: 1 inch thick.
- B. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. All Pipe Sizes: Insulation shall be one of the following:

- a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - c. Polyolefin: 1 inch thick.
- C. Condensate Drain Piping where installed within building:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- D. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Flexible Elastomeric: 1 inch thick.
 - c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.16 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. None.
 - 2. PVC, Color-Coded by System: 20 mils or 30 mils thick.
 - 3. Aluminum, Smooth or Corrugated: 0.020 inch, 0.032 inch or 0.040 inch thick.
 - 4. Painted Aluminum, Smooth or Corrugated: 0.020 inch or 0.032 inch thick.
 - 5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish or Corrugated: 0.020 inch or 0.024 inch thick.
- D. Piping, Exposed:
 - 1. None.
 - 2. PVC, Color-Coded by System: 20 mils or 30 mils thick.
 - 3. Aluminum, Smooth or Corrugated: 0.020 inch, 0.032 inch or 0.040 inch thick.
 - 4. Painted Aluminum, Smooth or Corrugated: 0.020 inch or 0.032 inch thick.
 - 5. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish or Corrugated: 0.020 inch or 0.024 inch thick.

3.17 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220719

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SECTION 221116 - DOMESTIC WATER PIPING AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Copper tube and fittings.
 - 2. Ductile-iron pipe and fittings.
 - 3. Piping joining materials.
 - 4. Encasement for piping.
 - 5. Transition fittings.
 - 6. Dielectric fittings.

1.3 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

1.5 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on applicable piping.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type K water tube, drawn temper.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- E. Copper Unions:
 - 1. MSS SP-123.
 - 2. Cast-copper-alloy, hexagonal-stock body.
 - 3. Ball-and-socket, metal-to-metal seating surfaces.
 - 4. Solder-joint or threaded ends.
- F. Copper, Brass, or Bronze Pressure-Seal-Joint Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Elkhart Products Corporation.
 - c. Mueller Industries, Inc.
 - d. NIBCO INC.
 - 2. Fittings: Cast-brass, cast-bronze or wrought-copper with EPDM O-ring seal in each end. Sizes NPS 2-1/2 and larger with stainless steel grip ring and EPDM O-ring seal.
 - 3. Minimum 200-psig working-pressure rating at 250 deg F.
- G. Appurtenances for Grooved-End Copper Tubing:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Anvil International.
 - b. Grinnell Mechanical Products.
 - c. Shurjoint Piping Products USA Inc.
 - d. Victaulic Company.

2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75/B 75M copper tube or ASTM B 584 bronze castings.
3. Mechanical Couplings for Grooved-End Copper Tubing:
 - a. Copper-tube dimensions and design similar to AWWA C606.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.
 - e. Minimum Pressure Rating: 300 psig.

2.3 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe:
 1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Standard-Pattern, Mechanical-Joint Fittings:
 1. AWWA C110/A21.10, ductile or gray iron.
 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- C. Compact-Pattern, Mechanical-Joint Fittings:
 1. AWWA C153/A21.53, ductile iron.
 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- D. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.
- E. Appurtenances for Grooved-End, Ductile-Iron Pipe:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Shurjoint Piping Products USA Inc.
 - b. Smith-Cooper International.
 - c. Victaulic Company.
 2. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions that match pipe.
 3. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:
 - a. AWWA C606 for ductile-iron-pipe dimensions.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.
 - e. Minimum Pressure Rating:
 - 1) NPS 14 to NPS 18: 250 psig.
 - 2) NPS 20 to NPS 46: 150 psig.

2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105/A21.5.
- B. Form: Sheet or tube.
- C. Color: Black or natural.

2.6 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Dresser, Inc.
 - b. Jay R. Smith Mfg. Co.
 - c. JCM Industries, Inc.
 - d. Smith-Blair, Inc.
- D. Plastic-to-Metal Transition Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
 - d. Uponor.
 2. Description:
 - a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
 - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.
- E. Plastic-to-Metal Transition Unions:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Colonial Engineering, Inc.
 - b. NIBCO INC.
 - c. Spears Manufacturing Company.
 2. Description:
 - a. CPVC or PVC four-part union.
 - b. Brass or stainless-steel threaded end.
 - c. Solvent-cement-joint or threaded plastic end.
 - d. Rubber O-ring.
 - e. Union nut.

2.7 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. A.Y. McDonald Mfg. Co.
 - b. Central Plastics Company.
 - c. Matco-Norca.
 - d. Wilkins.
 2. Standard: ASSE 1079.
 3. Pressure Rating: 125 psig minimum at 180 deg F.
 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Central Plastics Company.
 - b. Matco-Norca.
 - c. WATTS.
 - d. Wilkins.

2. Standard: ASSE 1079.
 3. Factory-fabricated, bolted, companion-flange assembly.
 4. Pressure Rating: 125 psig minimum at 180 deg F.
 5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 2. Nonconducting materials for field assembly of companion flanges.
 3. Pressure Rating: 150 psig.
 4. Gasket: Neoprene or phenolic.
 5. Bolt Sleeves: Phenolic or polyethylene.
 6. Washers: Phenolic with steel backing washers.
- E. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products.
 - c. Matco-Norca.
 - d. Precision Plumbing Products.
 2. Standard: IAPMO PS 66.
 3. Electroplated steel nipple complying with ASTM F 1545.
 4. Pressure Rating and Temperature: 300 psig at 225 deg F.
 5. End Connections: Male threaded or grooved.
 6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

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

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction

loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- H. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- N. Install piping to permit valve servicing.
- O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- P. Install piping free of sags and bends.
- Q. Install fittings for changes in direction and branch connections.

- R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- S. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- T. Install thermostats in hot-water circulation piping. Low temperature reading on the thermostat shall activate the circulating pump.
- U. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

- G. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- H. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- I. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- J. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- K. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

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

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings, nipples or unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits or nipples.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
 - 7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 - 7. NPS 6: 12 feet with 3/4-inch rod.
 - 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.

3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

- J. Install supports for vertical stainless-steel piping every 15 feet.
- K. Support piping and tubing not listed in this article according to MSS SP-58 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

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

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

- b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - f. Prepare reports for tests and for corrective action required.
 - B. Domestic water piping will be considered defective if it does not pass tests and inspections.
 - C. Prepare test and inspection reports.
- 3.10 ADJUSTING
- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.

8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

- D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
 - 2. Mechanical-joint, ductile-iron pipe; standard or compact-pattern, mechanical-joint fittings; and mechanical joints.
 - 3. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- F. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12, shall be one of the following:
 - 1. Mechanical-joint, ductile-iron pipe; standard-pattern, mechanical-joint fittings; and mechanical joints.
 - 2. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- G. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- H. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast or wrought-copper, solder-joint fittings; and brazed or soldered joints.
 - 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
- I. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast or wrought-copper, solder-joint fittings; and brazed or soldered joints.
 - 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.
 - 3. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.
- J. Aboveground domestic water piping, NPS 5 to NPS 8, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast or wrought-copper, solder-joint fittings; and brazed or soldered joints.
 - 2. Hard copper tube, ASTM B 88, Type L; grooved-joint, copper-tube appurtenances; and grooved joints.
 - 3. Stainless-steel Schedule 10 or Schedule 40 pipe, grooved-joint fittings, and grooved joints.
- K. Aboveground, combined domestic water-service and fire-service-main piping, NPS 6 to NPS 12, shall be one of the following:

1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
2. Stainless-steel Schedule 10 or Schedule 40 pipe, grooved-joint fittings, and grooved joints.

3.13 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated or Memory-stop balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

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SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Automatic water shutoff valves.
 - 5. Balancing valves.
 - 6. Temperature-actuated, water mixing valves.
 - 7. Strainers.
 - 8. Outlet boxes.
 - 9. Hose bibbs.
 - 10. Drain valves.
 - 11. Water-hammer arresters.
 - 12. Trap-seal primer valves.
 - 13. Trap-seal primer systems.
 - 14. Flexible connectors.
 - 15. Water meters.
- B. Related Requirements:
 - 1. Section 220519 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 2. Section 221116 "Domestic Water Piping" for water meters.
 - 3. Section 224713 "Drinking Fountains" for water filters for water coolers.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

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

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 and NSF 14. Mark "NSF-pw" on applicable plastic piping components.
- B. Comply with NSF 372 for low lead.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. FEBCO; A WATTS Brand.
 - c. WATTS.
 - d. Zurn Industries, LLC.
 - 2. Standard: ASSE 1001.
 - 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: Threaded.
 - 6. Finish: Rough bronze or Chrome plated.
- B. Hose-Connection Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.

- b. Cash Acme, A Division of Reliance Worldwide Corporation.
 - c. WATTS.
 - d. Zurn Industries, LLC.
 2. Standard: ASSE 1011.
 3. Body: Bronze, nonremovable, with manual drain.
 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 5. Finish: Chrome or nickel plated.
- C. Pressure Vacuum Breakers:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. FEBCO; A WATTS Brand.
 - c. WATTS.
 - d. Zurn Industries, LLC.
 2. Standard: ASSE 1020.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 5 psig maximum, through middle third of flow range.
 5. Size: Refer to Plumbing design drawings.
 6. Design Flow Rate: Refer to Plumbing design drawings.
 7. Selected Unit Flow Range Limits: Refer to Plumbing design drawings.
 8. Pressure Loss at Design Flow Rate: Refer to Plumbing design drawings.
 9. Accessories: Refer to Plumbing design drawings.
 - a. Valves: Ball type, on inlet and outlet.
- D. Laboratory-Faucet Vacuum Breakers:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. WATTS.
 - c. Woodford Manufacturing Company.
 - d. Zurn Industries, LLC.
 2. Standard: ASSE 1035.
 3. Size: NPS 1/4 or NPS 3/8 matching faucet size.
 4. Body: Bronze.
 5. End Connections: Threaded.
 6. Finish: Chrome plated.
- E. Spill-Resistant Vacuum Breakers:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. WATTS.
 - c. Zurn Industries, LLC.
 2. Standard: ASSE 1056.
 3. Operation: Continuous-pressure applications.

4. Size: NPS 1/4, NPS 3/8, NPS 1/2, NPS 3/4 or NPS 1.
5. Accessories: Refer to Plumbing design drawings.
 - a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. FEBCO; A WATTS Brand.
 - c. WATTS.
 - d. Zurn Industries, LLC.
2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2 or NPS 3/4.
5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Chrome plated or Rough bronze.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. FEBCO; A WATTS Brand.
 - c. WATTS.
 - d. Zurn Industries, LLC.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle third of flow range.
5. Size: Refer to Plumbing design drawings.
6. Design Flow Rate: Refer to Plumbing design drawings.
7. Selected Unit Flow Range Limits: Refer to Plumbing design drawings.
8. Pressure Loss at Design Flow Rate: Refer to Plumbing design drawings.
9. Body: Bronze for NPS 2 and smaller; cast iron or steel with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
11. Configuration: Designed for horizontal, straight-through or vertical-inlet, horizontal-center-section, and vertical-outlet flow.
12. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check, Backflow-Prevention Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. FEBCO; A WATTS Brand.
 - c. WATTS.
 - d. Zurn Industries, LLC.
 2. Standard: ASSE 1015.
 3. Operation: Continuous-pressure applications unless otherwise indicated.
 4. Pressure Loss: 5 psig maximum, through middle third of flow range.
 5. Size: Refer to Plumbing design drawings.
 6. Design Flow Rate: Refer to Plumbing design drawings.
 7. Selected Unit Flow Range Limits: Refer to Plumbing design drawings.
 8. Pressure Loss at Design Flow Rate: Refer to Plumbing design drawings.
 9. Body: Bronze for NPS 2 and smaller; cast iron or steel with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
 10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 11. Configuration: Designed for horizontal, straight-through flow.
 12. Accessories:
 - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
- D. Beverage-Dispensing-Equipment Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. WATTS.
 - c. Zurn Industries, LLC.
 2. Standard: ASSE 1022.
 3. Operation: Continuous-pressure applications.
 4. Size: NPS 1/4 or NPS 3/8.
 5. Body: Stainless steel.
 6. End Connections: Threaded.
- E. Dual-Check-Valve Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. FEBCO; A WATTS Brand.
 - c. WATTS.
 - d. Zurn Industries, LLC.
 2. Standard: ASSE 1024.
 3. Operation: Continuous-pressure applications.
 4. Size: NPS 1/2, NPS 3/4, NPS 1 or NPS 1-1/4.
 5. Body: Bronze with union inlet.

- F. Carbonated-Beverage-Dispenser, Dual-Check-Valve Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cash Acme, A Division of Reliance Worldwide Corporation.
 - b. Lancer Corporation.
 - c. WATTS.
 2. Standard: ASSE 1032.
 3. Operation: Continuous-pressure applications.
 4. Size: NPS 1/4 or NPS 3/8.
 5. Body: Stainless steel.
 6. End Connections: Threaded.
- G. Reduced-Pressure-Detector, Fire-Protection, Backflow-Preventer Assemblies:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. FEBCO; A WATTS Brand.
 - c. WATTS.
 - d. Zurn Industries, LLC.
 2. Standard: ASSE 1047 and is FM Global approved or UL listed.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 12 psig maximum, through middle third of flow range.
 5. Size: Refer to Plumbing/Fire Protection design drawings.
 6. Design Flow Rate: Refer to Plumbing/Fire Protection design drawings.
 7. Selected Unit Flow Range Limits: Refer to Plumbing/Fire Protection design drawings.
 8. Pressure Loss at Design Flow Rate: Refer to Plumbing/Fire Protection design drawings.
 9. Body: Cast iron or Steel with interior lining that complies with AWWA C550 or that is FDA approved or Stainless steel.
 10. End Connections: Flanged.
 11. Configuration: Designed for horizontal, straight-through or vertical-inlet, horizontal-center-section, and vertical-outlet flow.
 12. Accessories: Refer to Plumbing/Fire Protection design drawings.
 - a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
 - c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.
- H. Double-Check, Detector-Assembly Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. FEBCO; A WATTS Brand.
 - c. WATTS.
 - d. Zurn Industries, LLC.
 2. Standard: ASSE 1048 and is FM Global approved or UL listed.
 3. Operation: Continuous-pressure applications.

4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Size: Refer to Plumbing design drawings.
6. Design Flow Rate: Refer to Plumbing design drawings.
7. Selected Unit Flow Range Limits: Refer to Plumbing design drawings.
8. Pressure Loss at Design Flow Rate: Refer to Plumbing design drawings.
9. Body: Cast iron or Steel with interior lining that complies with AWWA C550 or that is FDA approved or Stainless steel.
10. End Connections: Flanged.
11. Configuration: Designed for horizontal, straight-through or vertical-inlet, horizontal-center-section, and vertical-outlet flow.
12. Accessories:
 - a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

I. Hose-Connection Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. WATTS.
 - c. Woodford Manufacturing Company.
2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

J. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. FEBCO; A WATTS Brand.
 - c. WATTS.
 - d. Zurn Industries, LLC.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Cash Acme, A Division of Reliance Worldwide Corporation.
 - c. WATTS.

- d. Zurn Industries, LLC.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Size: Refer to Plumbing design drawings.
5. Design Flow Rate: Refer to Plumbing design drawings.
6. Design Inlet Pressure: Refer to Plumbing design drawings.
7. Design Outlet Pressure Setting: Refer to Plumbing design drawings.
8. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
9. Valves for Booster Heater Water Supply: Include integral bypass.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water-Control Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. CLA-VAL Automatic Control Valves.
 - c. WATTS.
 - d. Zurn Industries, LLC.
2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
 - a. Size: Refer to Plumbing design drawings.
 - b. Pattern: Angle or Globe-valve design.
 - c. Trim: Stainless steel.
5. Design Flow: Refer to Plumbing design drawings.
6. Design Inlet Pressure: Refer to Plumbing design drawings.
7. Design Outlet Pressure Setting: Refer to Plumbing design drawings.
8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.6 AUTOMATIC WATER SHUTOFF VALVES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. DynaQuip Controls.
 2. FloLogic, Inc.
 3. OnSite PRO Inc.
 4. QMI Manufacturing Inc.
 5. Reliance Detection Technologies.
- B. Standards: NSF 61 and NSF 372.
- C. Shutoff Control Ball Valve:

1. Size: NPS 1/2, NPS 3/4, NPS 1, NPS 1-1/4, NPS 1-1/2 or NPS 2.
 2. Design Flow Rate: Refer to Plumbing design drawings.
 3. Design Inlet Pressure: Refer to Plumbing design drawings.
 4. Control Valve: Two-piece, full-port brass ball valve, MSS SP-110.
 - a. End Connections: Threaded, female.
 - b. Seats: PTFE.
 - c. O-Rings: FKM.
 - d. Stem: Low lead brass. Blowout proof.
 - e. CWP Rating: 600 psig.
 5. Manual override control turn-knob for emergency operation of the valve.
- D. Shutoff Control Butterfly Valve:
1. Size: NPS 2-1/2, NPS 3 or NPS 4.
 2. Compliance: MSS SP-67.
 3. Full-port, epoxy-coated, ductile-iron lug body.
 4. Seat: EPDM, minus 30 deg F to plus 250 deg F.
 5. Face-to-Face Flange: ASME B16.5 flanges.
 6. Disc Design: Floating stainless-steel dual shaft.
 7. Disc Material: Iron nylon 11 or Stainless steel.
 8. Locating Pin: Carbon steel.
 9. Bushings: PTFE.
 10. O-Rings: EPDM.
 11. Ten position stop.
 12. Manual override control turn-knob for emergency operation of the valve.
- E. Clothes Washer Shutoff Control Valve: Two-way, four-port, low-zinc bronze alloy valve.
1. End Connections: Male hose connections, NPS 3/4.
 2. Pressure Rating: 400 psi at 32 to 150 deg F.
 3. Maximum Test Pressure: 1200 psig.
 4. Stem Travel: 0.16 inch.
 5. Maximum Temperature: 250 deg F.
 6. Valve Stem: Burnished Type 303 stainless steel.
 7. Valve Stem Packing: Double EPDM.
 8. Valve Seat: Integral bronze.
 9. Valve Disc and Plunger: EPDM.
 10. Valve Spring: Stainless steel.
 11. Hoses: Two, 9-inch steel braided.
 12. Hose End Connections: One straight and one 90-degree elbow connection; both hoses.
- F. Clothes Washer Shutoff Control Valve Actuator: Two position, drive closed, spring open.
1. Housing: High-temperature composite glass-filled nylon.
 2. Connection to Valve: NPT female brass ring.
 3. Electric Motor: Reversible, brushless, and synchronism, maintains constant control speed to keep the cycle time constant. Maximum stem output is force balance controlled with electronic shutoff when end travel is detected in both directions.
 4. Maximum Working Force: 48 lbf.
 5. Power Requirements:
 - a. Input Voltage: 24 V ac.
 - b. Frequency: 60 or 50 Hz.

- c. Current: 0.045 A.
 - d. Power: 1 VA.
 - 6. Power Supply: 120-V ac to 24-V ac transformer with cord and plug.
 - 7. Working Time: 90 seconds.
 - 8. Duty Rating: 100 percent.
 - 9. Travel: 0.16 inch.
 - 10. Position Indicator: Standard.
 - 11. Working Temperature: 40 to 120 deg F.
 - 12. Conform to CE and ROHS requirements.
- G. Water Main Shutoff Valve Actuator: Motor operated, with or without gears, electric and electronic. Capable of closing valve against inlet pressure. Direct mount, two way; fails open/open or closed/closed.
 - 1. Actuator Torque: 133 or 266 in-lbf.
 - 2. Power Requirements:
 - a. Input Voltage: 12 or 24 V dc.
 - b. Frequency: 60 or 50 Hz.
 - c. Current: 2 A.
 - d. Power: 15 or 24 VA.
 - 3. Power Supply: 120-V ac to 12 or 24-V dc transformer with cord and plug.
 - 4. Working Time: 8 to 10 seconds.
 - 5. Torque Limiter: STD.
 - 6. Duty Rating: 50 or 75 percent.
 - 7. Protection: IP65 or IP67.
 - 8. Rotation: 90 or 180 degrees.
 - 9. Manual Intervention: Allowed.
 - 10. Position Indicator: Standard.
 - 11. Working Temperature: Minus 4 deg F to plus 131 deg F.
- H. Domestic Water Heater Shutoff Valve Actuator: Motor operated, with or without gears, electric and electronic. Capable of closing valve against inlet pressure. Direct mount, two way; fails open/open or close/close.
 - 1. Power Requirements:
 - a. Input Voltage: 24 V ac.
 - b. Frequency: 60 or 50 Hz.
 - c. Current: 0.6 A.
 - d. Power: 15 VA.
 - 2. Power Supply: 120-V ac to 24-V ac transformer with cord and plug.
 - 3. Working Time: 45 seconds.
 - 4. Rotation: 90 degrees.
 - 5. Manual Intervention: Allowed.
 - 6. Position Indicator: LED for closed position.
 - 7. Working Temperature: 0 to 100 deg F.
 - 8. Audible Alarm: 83 dB.
- I. Actuator Enclosure: Suitable for ambient conditions encountered by application.
 - 1. NEMA 250, Type 2 for indoor and protected applications.
 - 2. Material: Self-extinguishing class techno-polymer.

- J. Wireless Leak Detection Receiver System:
1. Onboard Battery Backup: 48 hours of protection. Valve to close prior to backup failure.
 2. LED Indicators: Wireless signal strength, communication loss, water fault, low temperature fault, and low battery.
 3. Output Contacts: Interface with home security or building automation system, cellular text notification service, or auto dialer accessories.
 4. FCC Approved Wireless Communication System: Between devices; sensors, repeaters, and receivers:
 - a. Proprietary 900-MHz wireless communication platform ensures system operation without Wi-Fi dependence or other communication platforms, subject to power and random service outages.
 - b. Automatic wireless communication testing and positive confirmation ensure system devices remain active and working correctly. Automatic fault notification for lost communication or missing device.
 5. Power Supply: 120 V ac or 9-V dc battery.
 6. Dual Function Wireless Sensors: 2. Valve closes if temperature falls below 45 deg F.
 - a. Wireless Signal Range: 100 feet between sensors and receiver.
 - b. Custom range finding feature.
 - c. LED Indicators: Wireless signal strength, communication loss, water fault, low temperature, and low battery.
 7. Self-monitoring enabled system; faults for lost communication between receiver and sensor(s).
 8. Closed-Loop RF System: System remains active even when power and Wi-Fi signals are lost.
- K. Wired Leak Detection System: Local water sensor.
1. Power Supply: Class II transformer with cord and plug, 120 V ac, UL listed.
 - a. Power Cord Length: 12 feet.
 2. Control Panel: LED power and LED valves indicator.
 3. Alarms: Audible alarm, with external output.
 4. Wired Sensors:
 - a. Quantity Per Receiver: 1 to 6.
 - b. Cable Length: 8, 25, 50 or 100 feet.
 5. Sensor Elevation: Elevated 1/2 inches above condensate drain pan.
- L. Accessories:
1. Water Flow Sensors: Pipe-mounted to detect water flow.
 2. Rope Sensor: Absorbent water sensing rope constructed from twisted metal conductor wires insulated from one another and surrounded by polyethylene mesh braid jacket. Connect up to 100 feet (10 sections) of sensor rope to a single receiver.
 3. Electrical Plug Interrupter: Plugs into standard 120-V ac wall outlet.
 4. Gas Flow Interrupter: ECO Connector with female spade connectors. Factory prewired, 8 feet.
 5. Gas Interface Cable: Interface cable with male and female connectors.
 6. Step-Down Transformer: 120, 208 or 240 V ac to 24 V ac with mounting plate, 12-foot plenum wire to power, and 8-foot plenum wire to sensor.
 7. Liquid Level Sensors: Monitor fluid levels in addition to detecting plumbing leaks.
 8. Auto Dialer: Send and receive automatic alerts when a fault condition occurs. Standard output contacts trigger up to nine predetermined telephone number calls.

- a. Prerecord message for future playback.
 - b. 10-second recordable message.
 - c. Built-in tamper switch.
 - d. DC adaptor with battery backup.
 - e. Programmable as a silent (dialer only) or audible (siren and dialer) alarm.
 - f. Easy "Stop Call Sequence" - push "#" on phone to acknowledge the alarm and stop the dialing sequence.
9. Cellular Text Notification System.
 - a. Event SMS text notification to up to three cell phones.
 - b. Battery backup, four (4) AA batteries.
 - c. 12-foot interface cable to leak detection system.
 - d. Customized messaging.
 - e. Wireless network or Service provider:
10. Cable Adder: 10, 25, 50 or 100 feet in length.
11. Wireless Signal Repeater: Boosts signal performance between wireless sensors and receiver.
 - a. Push-button pairing and unpairing, into and out of the network.
 - b. Visual indication of wireless signal strength, low battery, and lost communication.
 - c. Standard wall outlet, 120 V ac, power.
 - d. Battery backup: Two (2) AA batteries for battery backup to maintain system integrity during a power outage.
12. Wireless Water Switch: Allows manual override or wireless system functionality and closes the valve to shut off water flow.
13. Hard-Wired Water Switch: Allows manual override or wireless system functionality and closes the valve to shut off water flow.

2.7 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Armstrong International, Inc.
 - b. ITT Corporation.
 - c. NIBCO INC.
 - d. TACO Comfort Solutions, Inc.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
3. Body: Brass or bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Armstrong International, Inc.
 - b. ITT Corporation.
 - c. NIBCO INC.

- d. WATTS.
 - 2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
 - 3. Size: Same as connected piping, but not smaller than NPS 2-1/2.
- C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- D. Memory-Stop Balancing Valves:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Red White Valve Corp.
 - 2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
 - 3. Pressure Rating: 400-psig minimum CWP.
 - 4. Size: NPS 2 or smaller.
 - 5. Body: Copper alloy.
 - 6. Port: Standard or full port.
 - 7. Ball: Chrome-plated brass.
 - 8. Seats and Seals: Replaceable.
 - 9. End Connections: Solder joint or threaded.
 - 10. Handle: Vinyl-covered steel with memory-setting device.

2.8 TEMPERATURE-ACTUATED, WATER MIXING VALVES

- A. Water-Temperature Limiting Devices:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Leonard Valve Company.
 - c. POWERS; A WATTS Brand.
 - d. Symmons Industries, Inc.
 - 2. Standard: ASSE 1017.
 - 3. Pressure Rating: 125 psig.
 - 4. Type: Thermostatically controlled, water mixing valve.
 - 5. Material: Bronze body with corrosion-resistant interior components.
 - 6. Connections: Threaded or union inlets and outlet.
 - 7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 - 8. Tempered-Water Setting: Refer to Plumbing design drawings.
 - 9. Tempered-Water Design Flow Rate: Refer to Plumbing design drawings.
 - 10. Valve Finish: Chrome plated or Rough bronze.
- B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Lawler Manufacturing Company, Inc.
 - b. Leonard Valve Company.
 - c. POWERS; A WATTS Brand.
 - d. Symmons Industries, Inc.
 2. Standard: ASSE 1017.
 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
 4. Type: Exposed-mounted or Cabinet-type, thermostatically controlled, water mixing valve.
 5. Material: Bronze body with corrosion-resistant interior components.
 6. Connections: Threaded union inlets and outlet.
 7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
 8. Tempered-Water Setting: Refer to Plumbing design drawings.
 9. Tempered-Water Design Flow Rate: Refer to Plumbing design drawings.
 10. Selected Valve Flow Rate at 45-psig Pressure Drop: Refer to Plumbing design drawings.
 11. Pressure Drop at Design Flow Rate: Refer to Plumbing design drawings.
 12. Valve Finish: Polished, chrome plated or Rough bronze.
 13. Piping Finish: Chrome plated or Copper.
 14. Cabinet: Factory fabricated, stainless steel, for recessed or surface mounting and with hinged, stainless-steel door.
- C. Individual-Fixture, Water Tempering Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Apollo Flow Controls; Conbraco Industries, Inc.
 - b. Lawler Manufacturing Company, Inc.
 - c. Leonard Valve Company.
 - d. POWERS; A WATTS Brand.
 2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
 3. Pressure Rating: 125 psig minimum unless otherwise indicated.
 4. Body: Bronze body with corrosion-resistant interior components.
 5. Temperature Control: Adjustable.
 6. Inlets and Outlet: Threaded.
 7. Finish: Rough or chrome-plated bronze.
 8. Tempered-Water Setting: Refer to Plumbing design drawings.
 9. Tempered-Water Design Flow Rate: Refer to Plumbing design drawings.
- D. Primary Water Tempering Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Heat-Timer Corporation.
 - b. Holby Valve Inc.
 - c. Uponor.

2. Standard: ASSE 1017, thermostatically controlled, water tempering valve, listed as tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Body: Bronze.
5. Temperature Control: Manual.
6. Inlets and Outlet: Threaded.
7. Selected Primary Water Tempering Valve Size: Refer to Plumbing design drawings.
8. Tempered-Water Setting: Refer to Plumbing design drawings.
9. Tempered-Water Design Flow Rate: Refer to Plumbing design drawings.
10. Pressure Drop at Design Flow Rate: Refer to Plumbing design drawings.
11. Tempered-Water Outlet Size: Refer to Plumbing design drawings.
12. Cold-Water Inlet Size: Refer to Plumbing design drawings.
13. Hot-Water Inlet Size: Refer to Plumbing design drawings.
14. Valve Finish: Rough bronze.

2.9 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020, 0.033, or 0.062 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045, 0.062 or 0.125 inch.
 - c. Strainers NPS 5 and Larger: 0.10, 0.125 or 0.25 inch.
6. Drain: Pipe plug and Factory-installed, hose-end drain valve.

2.10 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Guy Gray Manufacturing Co., Inc.
 - b. IPS Corporation.
 - c. LSP Products Group, Inc.
 - d. Oatey.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel, epoxy-painted-steel or Stainless-steel box and faceplate.
4. Faucet: Combination valved fitting or separate hot- and cold-water valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.

6. Drain: NPS 1-1/2 or NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
7. Inlet Hoses: Two 60-inch-long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
8. Drain Hose: One 48-inch-long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. IPS Corporation.
 - b. LSP Products Group, Inc.
 - c. Oatey.
 - d. Plastic Oddities.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel, epoxy-painted-steel or Stainless-steel box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.11 HOSE BIBBS

A. Hose Bibbs:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Acorn Manufacturing.
 - b. Jay R. Smith Mfg. Co.
 - c. Woodford Manufacturing Company.
 - d. Zurn Industries, LLC.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Rough bronze, Chrome or nickel plated.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Wheel handle or Operating key.
14. Operation for Finished Rooms: Operating key.
15. Include operating key with each operating-key hose bibb.

16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.12 DRAIN VALVES

- A. Ball-Valve-Type, Hose-End Drain Valves:
 1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
 2. Pressure Rating: 400-psig minimum CWP.
 3. Size: NPS 3/4.
 4. Body: Copper alloy.
 5. Ball: Chrome-plated brass.
 6. Seats and Seals: Replaceable.
 7. Handle: Vinyl-covered steel.
 8. Inlet: Threaded or solder joint.
 9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.
- B. Gate-Valve-Type, Hose-End Drain Valves:
 1. Standard: MSS SP-80 for gate valves.
 2. Pressure Rating: Class 125.
 3. Size: NPS 3/4.
 4. Body: ASTM B 62 bronze.
 5. Inlet: NPS 3/4 threaded or solder joint.
 6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.
- C. Stop-and-Waste Drain Valves:
 1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
 2. Pressure Rating: 200-psig minimum CWP or Class 125.
 3. Size: NPS 3/4.
 4. Body: Copper alloy or ASTM B 62 bronze.
 5. Drain: NPS 1/8 side outlet with cap.

2.13 WATER-HAMMER ARRESTERS

- A. Water-Hammer Arresters:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. MIFAB, Inc.
 - b. Precision Plumbing Products.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. WATTS.
 2. Standard: ASSE 1010 or PDI-WH 201.
 3. Type: Metal bellows or Copper tube with piston.
 4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.14 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg. Co.
 - b. MIFAB, Inc.
 - c. Precision Plumbing Products.
 - d. WATTS.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg. Co.
2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
3. Size: NPS 1-1/4 minimum.
4. Material: Chrome-plated, cast brass.

2.15 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Precision Plumbing Products.
 - b. Zurn Industries, LLC.
2. Standard: ASSE 1044.
3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
4. Cabinet: Recessed or Surface-mounted steel box with stainless-steel cover.
5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
 - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Vacuum Breaker: ASSE 1001.
7. Number Outlets: Refer to Plumbing design drawings.
8. Size Outlets: NPS 1/2 or NPS 5/8.

2.16 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Flex-Hose Co., Inc.
 - 2. Flexicraft Industries.
 - 3. Flex-Weld, Inc.
 - 4. Metraflex Company (The).
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig to 250 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig to 250 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

2.17 WATER METERS

- A. Displacement-Type Water Meters:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AALIANT.
 - b. ABB.
 - c. Mueller Co.
 - d. Sensus.
 - 2. Standard: AWWA C700.
 - 3. Pressure Rating: 150-psig working pressure.
 - 4. Body Design: Nutating disc; totalization meter.
 - 5. Registration: In gallons or cubic feet as required by utility company.
 - 6. Case: Bronze.
 - 7. End Connections: Threaded.
- B. Turbine-Type Water Meters:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Badger Industries, Inc.
 - b. Hays Fluid Controls.
 - c. Master Meter, Inc.
 - d. Sensus.
 - 2. Standard: AWWA C701.
 - 3. Pressure Rating: 150 psig working pressure.

4. Body Design: Turbine; totalization meter.
 5. Registration: In gallons or cubic feet as required by utility company.
 6. Case: Bronze.
 7. End Connections for Meters NPS 2 and Smaller: Threaded.
 8. End Connections for Meters NPS 2-1/2 and Larger: Flanged.
- C. Compound-Type Water Meters:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Badger Industries, Inc.
 - b. Master Meter, Inc.
 - c. Mueller Co.
 - d. Sensus.
 2. Standard: AWWA C702.
 3. Pressure Rating: 150-psig working pressure.
 4. Body Design: With integral mainline and bypass meters; totalization meter.
 5. Registration: In gallons or cubic feet as required by utility company.
 6. Case: Bronze.
 7. Pipe Connections: Flanged.
- D. Remote Registration System: Encoder type complying with AWWA C707; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility company.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Backflow Preventers: Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- B. Water Regulators: Install with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- C. Water Control Valves: Install with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.
- D. Automatic Water Shutoff Valves: Test for signal strength before valve installation. Install automatic shutoff valve downstream from main domestic water shutoff valve and downstream

from fire sprinkler system supply. Install valve controller in an accessible location with sensors in areas where water is likely to accumulate.

- E. Balancing Valves: Install in locations where they can easily be adjusted.
- F. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- G. Y-Pattern Strainers: For water, install on supply side of each control valve, water pressure-reducing valve, solenoid valve and/or pump.
- H. Outlet Boxes: Install boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- I. Water-Hammer Arresters: Install in water piping according to PDI-WH 201.
- J. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- K. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- L. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.
- C. Comply with requirements for grounding equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

3.3 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Intermediate atmospheric-vent backflow preventers.
 - 3. Reduced-pressure-principle backflow preventers.

4. Double-check, backflow-prevention assemblies.
5. Carbonated-beverage-machine backflow preventers.
6. Dual-check-valve backflow preventers.
7. Reduced-pressure-detector, fire-protection, backflow-preventer assemblies.
8. Double-check, detector-assembly backflow preventers.
9. Water pressure-reducing valves.
10. Automatic water shutoff valves.
11. Calibrated balancing valves.
12. Primary, thermostatic, water mixing valves.
13. Manifold, thermostatic, water mixing-valve assemblies.
14. Photographic-process, thermostatic, water mixing-valve assemblies.
15. Primary water tempering valves.
16. Outlet boxes.
17. Supply-type, trap-seal primer valves.
18. Trap-seal primer systems.

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

3.4 FIELD QUALITY CONTROL

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

3.5 ADJUSTING

- 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 AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings.
 - 3. Ductile-iron pipe and fittings.
 - 4. Copper tube and fittings.
 - 5. Specialty pipe fittings.
 - 6. Encasement for underground metal piping.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

1.4 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect, Construction Manager and Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Architect's, Construction Manager's and Owner's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 1. Soil, Waste, and Vent Piping: 10-foot head of water.
 2. Waste, Force-Main Piping: 50 psig, 100 psig or 150 psig.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 PIPING MATERIALS

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Single-Stack Aerator Fittings: ASME B16.45, hubless, cast-iron aerator and deaerator drainage fittings.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Conine Manufacturing Co., Inc.
 - b. SE Sovent.
- C. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. ANACO-Husky.
 - b. Fernco Inc.
 - c. Mission Rubber Company, LLC; a division of MCP Industries.
 - d. Tyler Pipe; a subsidiary of McWane Inc.
2. Standards: ASTM C 1277 and CISPI 310.
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. ANACO-Husky.
 - b. Charlotte Pipe and Foundry Company.
 - c. Mission Rubber Company, LLC; a division of MCP Industries.
 - d. Tyler Pipe; a subsidiary of McWane Inc.
2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

E. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. MG Piping Products Company.
2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.5 DUCTILE-IRON PIPE AND FITTINGS

A. Ductile-Iron, Mechanical-Joint Piping:

1. Ductile-Iron Pipe: AWWA C151/A21.51, with mechanical-joint bell and plain spigot ends unless grooved or flanged ends are indicated.
2. Ductile-Iron Fittings: AWWA C110/A21.10, mechanical-joint, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern.
3. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Ductile-Iron, Grooved-Joint Piping: AWWA C151/A21.51, with round-cut-grooved ends according to AWWA C606.

C. Ductile-Iron, Grooved-End Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Anvil International.
 - b. Shurjoint Piping Products USA Inc.
 - c. Smith-Cooper International.
 - d. Victaulic Company.
2. Grooved-End, Ductile-Iron Fittings: ASTM A 536 ductile-iron castings, with dimensions matching AWWA C110/A 21.10 ductile-iron pipe or AWWA C153/A 21.53 ductile-iron fittings, and complying with AWWA C606 for grooved ends.
3. Grooved Mechanical Couplings for Ductile-Iron Pipe: ASTM F 1476, Type I. Include ferrous housing sections with continuous curved keys; EPDM-rubber center-leg gasket suitable for hot and cold water; and bolts and nuts.

2.6 COPPER TUBE AND FITTINGS

- A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.
- D. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
- E. Copper Pressure Fittings:
 1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.7 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 2. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company, LLC; a division of MCP Industries.
 - 4) Plastic Oddities.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. End Connections: Same size as and compatible with pipes to be joined.
 - e. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
 3. Shielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company, LLC; a division of MCP Industries.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. End Connections: Same size as and compatible with pipes to be joined.
 4. Pressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) EBAA Iron, Inc.
 - 3) Jay R. Smith Mfg. Co.
 - 4) JCM Industries, Inc.
 - b. Standard: AWWA C219.
 - c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - d. Center-Sleeve Material: Manufacturer's standard, Carbon steel, Stainless steel, Ductile iron or Malleable iron.
 - e. Gasket Material: Natural or synthetic rubber.
 - f. Metal Component Finish: Corrosion-resistant coating or material.
- B. Dielectric Fittings:
1. Dielectric Unions:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) A.Y. McDonald Mfg. Co.
 - 2) HART Industrial Unions, LLC.
 - 3) Matco-Norca.

- 4) Zurn Industries, LLC.
- b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 125 psig minimum at 180 deg F.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
2. Dielectric Flanges:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Matco-Norca.
 - 4) Zurn Industries, LLC.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 125 psig minimum at 180 deg F.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
3. Dielectric-Flange Insulating Kits:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Advance Products & Systems, Inc.
 - 2) Calpico, Inc.
 - 3) Central Plastics Company.
 - 4) Pipeline Seal and Insulator, Inc.
 - b. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: 150 psig.
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel backing washers.
4. Dielectric Nipples:
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1) Elster Perfection Corporation.
 - 2) Grinnell Mechanical Products.
 - 3) Matco-Norca.
 - 4) Precision Plumbing Products.
 - b. Description:
 - 1) Standard: IAPMO PS 66.
 - 2) Electroplated steel nipple.
 - 3) Pressure Rating: 300 psig at 225 deg F.
 - 4) End Connections: Male threaded or grooved.
 - 5) Lining: Inert and noncorrosive, propylene.

2.8 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural.

PART 3 - EXECUTION

3.1 EARTH MOVING

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

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.

- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 - 3. Do not change direction of flow more than 90 degrees.
 - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- L. Lay buried building waste piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- M. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 or 2 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- O. Install steel piping according to applicable plumbing code.
- P. Install stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.
- Q. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- R. Install engineered soil and waste and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- S. Install underground, ductile-iron, force-main piping according to AWWA C600.

1. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints.
 2. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
 3. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
- T. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
1. Install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.
- U. Install force mains at elevations indicated.
- V. Plumbing Specialties:
1. Install backwater valves in sanitary waster gravity-flow piping.
 - a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
 - b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 3. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- W. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- X. Install sleeves for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- Y. Install sleeve seals for piping penetrations of concrete walls and slabs.
1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- Z. Install escutcheons for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
- 3.3 JOINT CONSTRUCTION
- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

- C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
 - 1. Cut threads full and clean using sharp dies.
 - 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - c. Do not use pipe sections that have cracked or open welds.
- E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.
- F. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- G. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in ODs.
 - 2. In Waste Drainage Piping: Unshielded or Shielded, nonpressure transition couplings.
 - 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
 - 4. In Underground Force Main Piping:
 - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
 - b. NPS 2 and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
 - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - 2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
 - 3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits or nipples.
 - 4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

- A. Comply with requirements in Section 220523 "General Duty Valves for Plumbing Piping" for valve installation requirements.

- B. Shutoff Valves:
 - 1. Install shutoff valve on each sewage pump discharge.
 - 2. Install gate or full-port ball valve for piping NPS 2 and smaller.
 - 3. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment." and Section 220548 "Vibration Controls for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 - 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 - 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.

4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
 6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 3. NPS 2: 10 feet with 3/8-inch rod.
 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 5. NPS 3: 12 feet with 1/2-inch rod.
 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 7. NPS 6 and NPS 8: 12 feet with 3/4-inch rod.
 8. NPS 10 and NPS 12: 12 feet with 7/8-inch rod.
- I. Install supports for vertical steel piping every 15 feet.
- J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 2: 84 inches with 3/8-inch rod.
 2. NPS 3: 96 inches with 1/2-inch rod.
 3. NPS 4: 108 inches with 1/2-inch rod.
 4. NPS 6: 10 feet with 5/8-inch rod.
- K. Install supports for vertical stainless-steel piping every 10 feet.
- L. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 4. NPS 3 and NPS 5: 10 feet with 1/2-inch rod.
 5. NPS 6: 10 feet with 5/8-inch rod.
 6. NPS 8: 10 feet with 3/4-inch rod.
- M. Install supports for vertical copper tubing every 10 feet.
- N. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
 - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Install horizontal backwater valves with cleanout cover flush with floor or in pit with pit cover flush with floor.
 - 6. Comply with requirements for backwater valves, cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 7. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Connect force-main piping to the following:
 - 1. Sanitary Sewer: To exterior force main.
 - 2. Sewage Pump: To sewage pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
 - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
 - a. Isolate test source and allow to stand for four hours.
 - b. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
 - 3. Stainless-steel pipe and fittings, sealing rings, and gasketed joints.
 - 4. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 - 5. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
 - 3. Stainless-steel pipe and fittings, sealing rings, and gasketed joints.
 - 4. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
 - 3. Stainless-steel pipe and fittings gaskets, and gasketed joints.
 - 4. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
 - 5. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 5 and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.

3. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
1. Extra Heavy or Service class, cast-iron soil piping; gaskets; and gasketed or calking materials; and calked joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI or heavy-duty hubless-piping couplings; and coupled joints.
 3. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
 4. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.
- G. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
1. Extra Heavy or Service class, cast-iron soil piping; gaskets; and gasketed or calking materials; and calked joints.
 2. Hubless, cast-iron soil pipe and fittings; CISPI or heavy-duty hubless-piping couplings; coupled joints.
 3. Dissimilar Pipe-Material Couplings: Unshielded or Shielded, nonpressure transition couplings.
- H. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 shall be any of the following:
1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
- I. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 shall be any of the following:
1. Hard copper tube, Type L; copper pressure fittings; and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
 3. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
- J. Underground sanitary-sewage force mains NPS 4 and smaller shall be any of the following:
1. Hard copper tube, Type L; wrought-copper pressure fittings; and soldered joints.
 2. Ductile-iron, mechanical-joint piping and mechanical joints.
 3. Ductile-iron, grooved-joint piping and grooved joints.
 4. Fitting-type transition coupling for piping smaller than NPS 1-1/2 and pressure transition coupling for NPS 1-1/2 and larger if dissimilar pipe materials.
- K. Underground sanitary-sewage force mains NPS 5 and larger shall be any of the following:
1. Hard copper tube, Type L; wrought-copper pressure fittings; and soldered joints.
 2. Ductile-iron, mechanical-joint piping and mechanical joints.
 3. Ductile-iron, grooved-joint piping and grooved joints.
 4. Pressure transition couplings if dissimilar pipe materials.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Backwater valves.
 - 2. Cleanouts.
 - 3. Roof flashing assemblies.
 - 4. Through-penetration firestop assemblies.
 - 5. Miscellaneous sanitary drainage piping specialties.
 - 6. Floor drains.
 - 7. Floor sinks.
 - 8. Trench drains.
 - 9. Channel drainage systems.
- B. Related Requirements:
 - 1. Section 221423 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene.
- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene.
- E. PE: Polyethylene.
- F. PP: Polypropylene.
- G. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Data: For each type of product. Include rated capacities, operating characteristics, and accessories for the following:
 - 1. FOG disposal systems.
- C. Shop Drawings:
 - 1. Show fabrication and installation details for frost-resistant vent terminals.
 - 2. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Data: For FOG disposal systems, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

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

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Cultures: Provide 1-gal. bottles of bacteria culture recommended by manufacturer of FOG disposal systems equal to 200 percent of amount installed, but no fewer than (2) 1-gal. bottles.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing, and marked for intended location and application.
- D. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

2.2 BACKWATER VALVES

- A. Horizontal, Cast-Iron Backwater Valves:
 - 1. <Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg. Co.
 - b. MIFAB, Inc.
 - c. WATTS.
 - d. Zurn Industries, LLC.
 - 2. Standard: ASME A112.14.1.
 - 3. Size: Same as connected piping.
 - 4. Body: Cast iron.
 - 5. Cover: Cast iron with bolted or threaded access check valve.
 - 6. End Connections: Hub and spigot or hubless.
 - 7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed or open for airflow unless subject to backflow condition as required.
 - 8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.
- B. Drain-Outlet Backwater Valves:
 - 1. <Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. WATTS.
 - d. Zurn Industries, LLC.
 - 2. Size: Same as floor drain outlet.
 - 3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
 - 4. Check Valve: Removable ball float.
 - 5. Inlet: Threaded.
 - 6. Outlet: Threaded or spigot.

2.3 CLEANOUTS

- A. Cast-Iron Exposed Cleanouts:

1. <Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg. Co.
 - b. MIFAB, Inc.
 - c. WATTS.
 - d. Zurn Industries, LLC.
 2. Standard: ASME A112.36.2M.
 3. Size: Same as connected drainage piping
 4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 5. Closure: Countersunk or raised-head, brass plug.
 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Stainless-Steel Exposed Cleanouts:
1. <Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. BLÜCHER; A Watts brand.
 - b. Josam Company.
 - c. WATTS.
 2. Standard: ASME A112.3.1.
 3. Size: Same as connected drainage piping
 4. Body Material: Stainless-steel tee with side cleanout as required to match connected piping.
 5. Closure: Stainless-steel plug with seal.
- C. Cast-Iron Exposed Floor Cleanouts:
1. <Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Company.
 - c. WATTS.
 - d. Zurn Industries, LLC.
 2. Standard: ASME A112.36.2M for heavy-duty, adjustable housing or threaded, adjustable housing cleanout.
 3. Size: Same as connected branch.
 4. Type: Heavy-duty, adjustable housing or Threaded, adjustable housing.
 5. Body or Ferrule: Cast iron.
 6. Clamping Device: As Required.
 7. Outlet Connection: Inside cask, Spigot or Threaded.
 8. Closure: Brass plug with straight threads and gasket or Brass plug with tapered threads.
 9. Adjustable Housing Material: Cast iron with threads or setscrews.
 10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy, Polished bronze or Rough bronze.
 11. Frame and Cover Shape: Round. Square when specifically requested by owner.
 12. Top Loading Classification: Heavy duty at exterior locations. Light or Medium Duty within building.

13. Riser: ASTM A 74, Extra-Heavy or Service class, cast-iron drainage pipe fitting and riser to cleanout.
- D. Stainless-Steel Exposed Floor Cleanouts:
1. <Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. BLÜCHER; A Watts brand.
 - b. Josam Company.
 - c. Kusel Equipment Co.
 - d. WATTS.
 2. Standard: ASME A112.3.1.
 3. Size: Same as connected branch.
 4. Housing: Stainless steel.
 5. Closure: Stainless steel with seal.
 6. Riser: ASTM A 74, Extra-Heavy or Service class, stainless-steel drainage pipe fitting and riser to cleanout.
 7. Body or Ferrule: Stainless steel.
 8. Clamping Device: As Required.
 9. Outlet Connection: Inside calk, Spigot or Threaded.
 10. Closure: Brass plug with straight threads and gasket or Brass plug with tapered threads.
 11. Adjustable Housing Material: Cast iron with threads or setscrews.
 12. Frame and Cover Material and Finish: Nickel-bronze, copper alloy or Stainless steel.
 13. Frame and Cover Shape: Round. Square when specifically requested by owner.
 14. Top Loading Classification: Heavy duty at exterior locations. Light or Medium Duty within building.
- E. Cast-Iron Wall Cleanouts:
1. <Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg. Co.
 - b. MIFAB, Inc.
 - c. WATTS.
 - d. Zurn Industries, LLC.
 2. Standard: ASME A112.36.2M. Include wall access.
 3. Size: Same as connected drainage piping.
 4. Body: Hub-and-spigot, cast-iron soil pipe T-branch or Hubless, cast-iron soil pipe test tee as required to match connected piping.
 5. Closure Plug:
 - a. Brass or Cast iron.
 - b. Countersunk or raised head.
 - c. Drilled and threaded for cover attachment screw.
 - d. Size: Same as or not more than one size smaller than cleanout size.
 6. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
 7. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. <Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Acorn Engineering Company.
 - b. Thaler Metal Industries Ltd.
 - c. Zurn Industries, LLC.
2. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch or 6.0-lb/sq. ft., 0.0938-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - a. Open-Top Vent Cap: Without cap.
 - b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 - c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. <Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve-and-stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded-PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.6 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564 rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
 - a. NPS 2: 4-inch-minimum water seal.
 - b. NPS 2-1/2 and Larger: 5-inch-minimum water seal.

- C. Floor-Drain, Trap-Seal Primer Fittings:
 - 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 - 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.
- D. Air-Gap Fittings:
 - 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 - 2. Body: Bronze or cast iron.
 - 3. Inlet: Opening in top of body.
 - 4. Outlet: Larger than inlet.
 - 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- E. Sleeve Flashing Device:
 - 1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch to 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 - 2. Size: As required for close fit to riser or stack piping.
- F. Stack Flashing Fittings:
 - 1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 - 2. Size: Same as connected stack vent or vent stack.
- G. Vent Caps:
 - 1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
 - 2. Size: Same as connected stack vent or vent stack.
- H. Expansion Joints:
 - 1. Standard: ASME A112.6.4.
 - 2. Body: Cast iron with bronze sleeve, packing, and gland.
 - 3. End Connections: Matching connected piping.
 - 4. Size: Same as connected soil, waste, or vent piping.

2.7 FLOOR DRAINS

- A. Cast-Iron Floor Drains:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg. Co.
 - b. MIFAB, Inc.
 - c. Wade; a subsidiary of McWane Inc.
 - d. WATTS.
 - 2. Standard: ASME A112.6.3 with backwater valve where required.

3. Pattern: Area or Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: As Required.
6. Anchor Flange: As Required.
7. Clamping Device: As Required.
8. Outlet: Bottom.
9. Backwater Valve: Drain-outlet type or Integral, ASME A112.14.1, swing-check type.
10. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
11. Sediment Bucket: As Required.
12. Top or Strainer Material: Nickel bronze or Stainless steel.
13. Top of Body and Strainer Finish: Nickel bronze or Stainless steel.
14. Top Shape: Round. Square when specifically requested by owner.
15. Dimensions of Top or Strainer: Refer to Plumbing Fixture Schedule on Construction Plans for body, sump, and grate requirements.
16. Top Loading Classification: Heavy duty at exterior locations. Light or Medium Duty within building.
17. Funnel: Not required.
18. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
19. Trap Material: Bronze, Cast iron or Copper.
20. Trap Pattern: Deep-seal P-trap or Standard P-trap.
21. Trap Features: Trap-seal primer valve drain connection.

B. Stainless-Steel Floor Drains, ASME A112.3.1:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Zurn Industries, LLC.
 - b. Jay R. Smith Mfg. Co.
 - c. MIFAB, Inc.
 - d. Wade; a subsidiary of McWane Inc.
 - e. Watts; a Watts Water Technologies company.
2. Outlet: Bottom or Side.
3. Top or Strainer Material: Stainless steel.
4. Top Shape: Round. Square when specifically requested by owner.
5. Dimensions of Top or Strainer: Refer to Plumbing Fixture Schedule on Construction Plans for body, sump, and grate requirements.
6. Seepage Flange: As Required.
7. Anchor Flange: As Required.
8. Clamping Device: As Required.
9. Trap-Primer Connection: Required.
10. Trap Material: Stainless steel.
11. Trap Pattern: Deep-seal P-trap or Standard P-trap.

2.8 FLOOR SINKS

A. Cast-Iron Floor Sinks:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg. Co.
 - b. MIFAB, Inc.
 - c. Wade; a subsidiary of McWane Inc.
 - d. Watts; a Watts Water Technologies company.
2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Cast iron.
5. Anchor Flange: As Required, with seepage holes.
6. Clamping Device: As Required.
7. Outlet: Bottom, no-hub connection.
8. Coating on Interior Surfaces: Acid-resistant enamel.
9. Sediment Bucket: Not required.
10. Internal Strainer: Dome or Flat.
11. Internal Strainer Material: Aluminum.
12. Top Grate Material: Cast iron, loose.
13. Top of Body and Grate Finish: Nickel bronze, Acid-resistant enamel.
14. Top Shape: Square.
15. Dimensions of Top Grate: Refer to Plumbing Fixture Schedule on Construction plans.
16. Top Loading Classification: No traffic.
17. Funnel: Not required.

2.9 TRENCH DRAINS

A. Trench Drains:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Jay R. Smith Mfg. Co.
 - b. MIFAB, Inc.
 - c. Wade; a subsidiary of McWane Inc.
 - d. WATTS.
2. Standard: ASME A112.6.3 for trench drains.
3. Material: Ductile or gray iron.
4. Flange: Anchor or Seepage, or As Required.
5. Clamping Device: As Required.
6. Outlet: Bottom, End or Side.
7. Grate Material: Ductile iron or Stainless steel.
8. Grate Finish: Painted or coated as required.
9. Dimensions of Frame and Grate: Refer to Plumbing Fixture Schedule on Construction plans for dimensions, body, sump, and grate requirements.
10. Top Loading Classification: Heavy duty at exterior locations. Light or Medium Duty within building.
11. Trap Material: Cast iron or Stainless steel.
12. Trap Pattern: Standard P-trap.

2.10 CHANNEL DRAINAGE SYSTEMS

A. Stainless-Steel Channel Drainage Systems, ASME A112.3.1:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Josam Company.
2. Description: Modular system of stainless-steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
3. Standard: ASME A112.3.1 for trench drains.
4. Channel Sections: Interlocking joint, stainless steel with level invert.
 - a. Dimensions: 4 or 6 inches wide. Include number of units required to form total lengths indicated. Refer to Plumbing Fixture Schedule on Construction Plans.
5. Grates: Manufacturer's designation "heavy or medium duty," with slots or perforations, and of width and thickness that fit recesses in channels.
 - a. Material: Stainless steel.
 - b. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
6. Covers: Stainless steel, of width and thickness that fit recesses in channels, and of lengths indicated.
7. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
8. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

B. Stainless-Steel Channel Drainage Systems, Non-ASME A112.3.1:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. MultiDrain Systems, Inc.
 - b. Zurn Industries, LLC.
2. Description: Modular system of stainless-steel channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
3. Channel Sections: Interlocking joint, stainless steel with level invert.
 - a. Dimensions: 4 or 6 inches wide. Include number of units required to form total lengths indicated.
4. Grates: Manufacturer's designation "heavy or medium duty," with slots or perforations, and of width and thickness that fit recesses in channels.
 - a. Material: Galvanized steel or Stainless steel.
 - b. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
5. Covers: Stainless steel, of width and thickness that fit recesses in channels, and of lengths indicated.
6. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
7. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

C. Narrow, Sloped-Invert, Polymer-Concrete Channel Drainage Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. ACO USA.
 - b. Jay R. Smith Mfg. Co.
 - c. MIFAB, Inc.
 - d. Polycast: Hubbell Power Systems, Inc.
 2. Description: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 3. Channel Sections: Narrow, interlocking-joint, sloped-invert, polymer-concrete modular units with end caps.
 - a. Include rounded bottom, with built-in invert slope of 0.6 percent and with outlets in number, sizes, and locations indicated.
 - b. Include extension sections necessary for required depth.
 - c. Dimensions: 4-inch inside width. Include number of units required to form total lengths indicated.
 - d. Frame: Gray-iron or galvanized steel for grates.
 4. Grates: Manufacturer's designation "heavy or medium duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.
 - a. Material: Stainless steel.
 - 1) Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
 5. Covers: Stainless Steel, of width and thickness that fit recesses in channel sections, and of lengths indicated.
 6. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 7. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
- D. Narrow, Level-Invert, Polymer-Concrete Channel Drainage Systems:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. ABT, Inc.
 - b. ACO USA.
 - c. Josam Company.
 - d. MIFAB, Inc.
 2. Description: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 3. Channel Sections: Narrow, interlocking-joint, precast, polymer-concrete modular units with end caps.
 - a. Include rounded bottom, with level invert and with NPS 4 outlets in number and locations indicated.
 - b. Dimensions: 5-inch inside width and 9-3/4 inches deep. Include number of units required to form total lengths indicated.
 - 1) Frame: Gray-iron or galvanized steel for grates.
 4. Grates: Manufacturer's designation "heavy or medium duty," with slots or perforations, and of width and thickness that fit recesses in channel sections.

- a. Material: Ductile iron, Fiberglass, Galvanized steel or Stainless steel.
 - b. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
 5. Covers: Stainless Steel, of width and thickness that fit recesses in channel sections, and of lengths indicated.
 6. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 7. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.
- E. FRP Channel Drainage Systems:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. ACO USA.
 - b. Aquaduct, Inc.
 - c. Jay R. Smith Mfg. Co.
 - d. Zurn Industries, LLC.
 2. Description: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
 3. Channel Sections: Interlocking-joint, sloped-invert, FRP modular units, with end caps. Include flat, rounded, or inclined inside bottom, with outlets in number, sizes, and locations indicated.
 - a. Dimensions: 4 or 6 inches wide. Include number of units required to form total lengths indicated. Refer to Plumbing Fixture Schedule on Construction Drawings.
 - b. Frame: Galvanized steel, Stainless steel or Manufacturer's standard metal for grates.
 4. Grates: With slots or perforations and widths and thickness that fit recesses in channel sections.
 - a. Material: Fiberglass or Stainless steel.
 - b. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
 5. Covers: Stainless Steel, of width and thickness that fit recesses in channel sections, and of lengths indicated.
 6. Supports, Anchors, and Setting Devices: Manufacturer's standard, unless otherwise indicated.
 7. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.11 MOTORS

- A. General requirements for motors are specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
1. Motor Sizes: Minimum size as indicated. If not indicated, motor shall be large enough, so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment Mounting:
 - 1. Install FOG disposal systems on cast-in-place concrete equipment base(s).
 - a. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Comply with requirements for vibration-isolation and seismic-control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
 - 3. Comply with requirements for vibration-isolation devices specified in Section 220548 "Vibration Controls for Plumbing Piping and Equipment."
- B. Install backwater valves in building drain piping.
 - 1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- H. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping."
- I. Assemble open drain fittings and install with top of hub 1 inch or 2 inches above floor.
- J. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- K. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 2. Size: Same as floor drain inlet.
- L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- M. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- N. Install vent caps on each vent pipe passing through roof.
- O. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- P. Assemble components of FOG disposal systems and install on floor.
1. Install trap, vent, fresh-air inlet, and flow-control fitting according to authorities having jurisdiction.
 2. Install shelf fastened to reinforcement in wall construction and adjacent to unit, unless otherwise indicated.
 3. Install culture bottle, culture metering pump, timer, and control on shelf. Install tubing between culture bottle, metering pump, and chamber.
- Q. Install wood-blocking reinforcement for wall-mounting-type specialties.
- R. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- S. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 3. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
 - a. Maintain integrity of waterproof membranes where penetrated.
 5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- T. Install trench drains at low points of surface areas to be drained.
1. Set grates of drains flush with finished surface, unless otherwise indicated.
- U. Comply with ASME A112.3.1 for installation of stainless-steel channel drainage systems.
1. Install on support devices, so that top will be flush with adjacent surface.

- V. Install FRP channel drainage system components on support devices, so that top will be flush with adjacent surface.
- W. Install plastic channel drainage system components on support devices, so that top will be flush with adjacent surface.
- X. Install open drain fittings with top of hub 1 inch to 2 inches above floor.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. FOG Disposal Systems: Connect inlet and outlet to unit, connect flow-control fitting and fresh-air inlet piping to unit inlet piping, and connect vent piping between trap and media chamber. Connect electrical power.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- F. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- G. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.
- H. Comply with requirements in Section 221323 "Sanitary Waste Interceptors" for grease interceptors, grease-removal devices, oil interceptors, sand interceptors, and solid interceptors.

3.3 FLASHING INSTALLATION

- A. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.
- C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.

2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- D. Set flashing on floors and roofs in solid coating of bituminous cement.
- E. Secure flashing into sleeve and specialty clamping ring or device.
- F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- G. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. FOG disposal systems.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections, and prepare test reports.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled FOG disposal systems and their installation, including piping and electrical connections, and to assist in testing.
- B. Tests and Inspections:
1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain FOG disposal systems.

END OF SECTION 221319

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SECTION 22 16 19 - DISINFECTION OF POTABLE WATER SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes the furnishing of all labor and materials for disinfection of the potable water system. Potable water systems are those systems which carry domestic water from the supply main without isolation of the branch by a backflow prevention device. Install all plumbing fittings and valves necessary to perform the disinfection.
- B. This section also includes the furnishing of all labor and materials to sample water in system following completion of procedure and provide bacteriological analysis of the water.

1.2 QUALIFICATIONS

- A. Disinfection: Disinfection shall be done by a commercial disinfection company approved by the University. Submit to the University's Representative the name of the proposed company for approval.
- B. Bacteriological Analysis: Water testing shall be done by a laboratory approved by the State Department of Health Services. Submit for approval the name of the proposed laboratory as well as the proposed number and location of samples.
- C. Provide a certificate of completion per Part B attached standard chlorination report which denotes the lines disinfected, the concentration applied and the amount and type of disinfection agent used, and that disinfection is in accordance with AWWA C-601 and State Health Department requirements.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Use an approved chlorine agent, applied in liquid form into the system being disinfected. Chlorine gas or a hypochlorite solution may be used to make up the disinfecting liquid.

PART 3 – EXECUTION

3.1 PRELIMINARY PREPARATION OF THE SYSTEM

- A. Provide within 3 feet of the supply main, an injection port for introducing the chlorine solution and a gate valve upstream from the injection port.
- B. There shall be no dead-end sections in the system exceeding 3 feet in length. All branches within the system shall lead to an outlet for bleeding and flushing.
- C. After final pressure tests, open each fixture or outlet to maximum flow and run until the discharge water is free from particulates.

3.2 CHLORINATION PROCEDURE

- A. Notify the University's Representative at least five working days prior to the start date of chlorination per Part A attached chlorination report.
- B. Install all fixtures to be served by the potable water system before start of chlorination.
- C. Prior to injection, place signs on each fixture being treated, reading "Heavily Chlorinated Water - Do Not Use."
- D. Introduce the chlorine into the supply stream at a rate to provide a uniform concentration of chlorine in the entire system. Maintain at least 50 ppm chlorine level at each fixture after a hold period of 24 hours. Do not exceed 150 ppm at any time.
- E. Draw the injected chlorine in the system through each outlet and fixture until the specified concentration level is reached. Then close all valves including the service cock and supply valve. Keep the system closed during the 24 hour hold period.
- F. The University will require a test for the residual concentration in the system at the end of 24 hours. Release no water from the system until these required samples are taken. A minimum concentration of 50 ppm of chlorine is required at all chosen sampling points.
- G. After approval to proceed, flush the system at a relatively high velocity to remove the injected chlorine to a concentration in the system of no more than 0.5 ppm above that in the normal supply.
- H. After approval to proceed, secure the entire system for at least three days prior to taking samples for bacteriological analysis.

3.3 SAMPLING AND NOTIFICATION

- A. At the completion of the three day hold period, take bacteriological water samples with observation by the University's Representative.
- B. Sample bottles must be provided by the approved laboratory. After the samples have been collected, the University's Representative may allow temporary use of the water system pending results of the bacteriological analysis of the samples. The system cannot be used unless such allowance in writing is given.
- C. Upon completion of sampling, submit the certificate of completion to the University's Representative for approval.

3.4 ANALYSIS

- A. Perform qualitative and quantitative bacterial analysis on the water samples and submit a laboratory report. The report must include the presence of any E. Coli bacteria in a 100 ml sample (this must be negative to be acceptable) and a total plate count of bacteria per cc of the sample (this must be less than 100, or equal to the supply).

3.5 FINAL ACCEPTANCE

- A. Upon satisfactory completion of all procedures and receipt of acceptable bacteriological results, written approval of the system will be provided by the University's Representative per Part C attached standard chlorination report. Failure to fully comply with the above procedures will result in a requirement to repeat the procedure until acceptable results are achieved, at no additional cost to the University.

END OF SECTION 22 16 19

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SECTION 23 00 00 – GENERAL MECHANICAL REQUIREMENTS

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 SCOPE

- A. Basic mechanical requirements specifically applicable to Division 23 Sections.
- B. Work includes but is not necessarily limited to the following:
 - 1. Labor, materials, services, equipment, and appliances required for completion of tasks as indicated on drawing or in specification or as inherently necessary to prepare spaces and systems for new installations as follows:
 - a. Heating, ventilating and air conditioning systems and equipment
 - b. Testing, adjusting and balancing

1.3 DRAWINGS AND SPECIFICATIONS

- A. Drawings accompanying these Specifications show intent of Work to be done. Specifications shall identify quality and grade of installation and where equipment and hardware is not particularly specified, Contractor shall provide submittals for all products and install them per manufacturers' recommendations, and in a first class manner.
- B. Examine Drawings and Specifications for elements in connection with this Work; determine existing and new general construction conditions and be familiar with all limitations caused by such conditions.
- C. Plans are intended to show general arrangement and extent of Work contemplated. Exact location and arrangement of parts shall be determined after the Owner has reviewed equipment, as Work progresses, to conform in best possible manner with surroundings, and as directed by the Owner's Representative.
- D. Contract Documents are in part diagrammatic and intended to show the scope and general arrangement of the Work under this Contract. The Contractor shall follow these drawings in laying out the equipment, piping, and ductwork. Drawings are not intended to be scaled for roughing in measurements or to serve as shop drawings. Where job conditions require minor changes or adjustments in the indicated locations or arrangement of the Work, such changes shall be made without change in the Contract amount.
- E. Follow dimensions without regard to scale. Where no figures or notations are given, the Plans shall be followed.

1.4 UTILITIES

- A. Location and sizes of electrical, mechanical, and plumbing service facilities are shown in accordance with data secured from existing record drawings and site observations. Data shown are offered as an estimating guide without guarantee of accuracy. Check and verify all data given, and verify exact location of all utility services pertaining to Work prior to excavation or performing Work.

1.5 APPLICABLE REFERENCE STANDARDS, CODES AND REGULATIONS

- A. Meet requirements of all state codes having jurisdiction.
- B. State of California Code of Regulations:
 - 1. Title 8, Industrial Relations
 - 2. Title 19, State Fire Marshal Regulations
 - 3. Current California Building Code (CBC), Title 24, Part 2
 - 4. Current California Electrical Code, Title 24, Part 3
 - 5. Current California Mechanical Code, Title 24, Part 4
 - 6. Current California Plumbing Code, Title 24, Part 5
 - 7. Current California Energy Code, Title 24, Part 6
 - 8. Current California Fire Code, Title 24, Part 9
 - 9. Current California Standards Code, Title 24, Part 12
- C. Additional Referenced Standards:
 - 1. AABC Associated Air Balance Council
 - 2. AMCA Air Moving and Conditioning Association
 - 3. ARI Air-Conditioning and Refrigeration Institute
 - 4. ASHRAE American Society of Heating, Refrigeration, and Air Conditioning Engineers
 - 5. ASME American Society of Mechanical Engineers
 - 6. ASTM American Society for Testing and Materials
 - 7. NEMA National Electrical Manufacturer's Association
 - 8. NFPA National Fire Protection Association Standards
 - 9. PDI Plumbing and Drainage Institute
 - 10. UL Underwriters Laboratories
- D. Codes and ordinances having jurisdiction over Work are minimum requirements; but, if Contract Documents indicate requirements, which are in excess of those minimum requirements, then requirements of the Contract Documents shall be followed. Should there be any conflicts between Contract Documents or codes or any ordinances having jurisdiction, report these to the Owner's Representative.
- E. Obtain permits, and request inspections from authority having jurisdiction.

1.6 PROJECT AND SITE CONDITIONS

- A. The arrangement of and connection to equipment shown on the Drawings is based upon information available and is not intended to show exact dimensions peculiar to a specific manufacturer. The Drawings are, in part, diagrammatic and some features of the illustrated equipment installations may require revision to meet actual equipment installation requirements.

Structural supports, housekeeping pads, piping connections and adjacent equipment may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions or alterations.

- B. Examine all Drawings and Specifications to be fully cognizant of all work required under this Division.
- C. Examine site related work and surfaces before starting work of any Section.
- D. Install Work in locations shown on approved Drawings, unless prevented by Project conditions.
- E. Prepare shop drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission from the Owner's Representative before proceeding.

1.7 COOPERATION WITH WORK UNDER OTHER DIVISIONS

- A. Cooperate with other trades to facilitate general progress of Work. Allow all other trades every reasonable opportunity for installation of their work.
- B. Work under this Division shall follow general building construction closely. Set pipe sleeves and inserts and verify that openings for chases and pipes are provided.
- C. Work with other trades in determining exact location of outlets, pipes, and pieces of equipment to avoid interference with lines required to maintain proper installation of Work.
- D. Make such progress in the Work to not delay work of other trades.

1.8 DISCREPANCIES

- A. The Contractor shall check all Drawings furnished him immediately upon their receipt and shall promptly notify the Owner's Representative of any discrepancies. Figures marked on Drawings shall in general be followed in preference to scale measurements. Piping and instrumentation diagrams shall in general govern floor plans and sections. Large-scale drawings shall in general govern small-scale drawings.
- B. Where requirements between Drawings and Specifications conflict, the more restrictive provisions shall apply.
- C. If any part of the Specifications or Drawings appears unclear or contradictory, apply to Owner's Representative for interpretation and decision as early as possible, including during bidding period. Do not proceed with such work without the Owner's Representative's decision. Beginning work of any Section constitutes acceptance of conditions.

1.9 CHANGES

- A. The Contractor shall be responsible to make and obtain approval from the Owner's Representative for all necessary adjustments in piping and equipment layouts as required to accommodate the relocations of equipment and/or devices, which are affected by any approved

authorized changes or Product substitutions. All changes shall be clearly indicated on the "Record" drawings.

1.10 SUBMITTALS

- A. Refer to Division 01 for additional requirements.
- B. The manufacturer, contractor or supplier shall include a written statement that the submitted equipment, hardware or accessory complies with the requirement of that particular specification section.
- C. The manufacturer shall resubmit the specification section showing compliance with each respective paragraphs and specified items and features in that particular specification section.
- D. All exceptions shall be clearly identified by referencing respective paragraph and other requirements along with proposed alternative.
- E. Note that prior to acceptance of submittals for review, a submittal schedule shall be submitted to the Owner's Representative.
- F. Submit all Division 23 shop drawings and product data grouped and referenced by the specification technical section number in one complete submittal package.
- G. Shop Drawings:
 - 1. Include installation details of equipment indicating proposed location, layout and arrangement, accessories, piping, and other items that must be shown to assure a coordinated installation.
 - 2. Indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.
 - 3. If equipment is rejected, revise drawings to show acceptable equipment and resubmit.
 - 4. Whenever more than one (1) manufacturer's product is specified, the first named product is the basis of design used in the Drawings and the use of alternate-named manufacturer's products or substitutes may require modifications to the design.
 - 5. The Contractor shall be responsible for all equipment ordered and/or installed prior to receipt of shop drawings returned from the Owner's Representative bearing the Owner's Representative stamp of "Reviewed". All corrections or modifications to the equipment as noted on the shop drawings shall be performed and equipment removed from the job site at the request of the Owner's Representative without additional compensation.
 - 6. Manufacturer's Data: For each manufactured item, provide current manufacturer's descriptive literature of cataloged products, certified equipment drawings, diagrams, performance and characteristic curves if applicable, and catalog cuts.
 - 7. Standard Compliance: When materials or equipment provided by the Contractor must conform to the standards of organizations such as American National Standards Institute (ANSI) or American Water Works Association (AWWA), submit proof of such conformance to the Owner Representative for approval. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified. In lieu of the label or listing, submit a certificate from an independent testing organization, which is competent to perform acceptance testing and is approved by the Owner Representative. The certificate shall

state that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's standard.

8. Certified Test Reports: Before delivery of materials and equipment, certified copies of all test reports specified in individual sections shall be submitted for approval.
9. Certificates of Compliance or Conformance: Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this Contract. Pre-printed certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; or "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance or conformance.

1.11 PROJECT RECORD DOCUMENTS

- A. Refer to Division 01 for additional requirements.
 1. All changes, deviations and information recorded on the "Project Record Drawings" set during Construction shall be redrafted onto the latest version of AutoCAD or Revit, where applicable.
 2. Submit completed shop drawings to the Owner prior to completion in AutoCAD format. Contractor hand marked or drafted redlined "Project Record Drawings" will not be accepted.

1.12 PRODUCT ALTERNATIVES OR SUBSTITUTIONS

- A. Refer to General Conditions and Division 01 for additional requirements.

1.13 OPERATING INSTRUCTIONS

- A. Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation and maintenance personnel.

1.14 MANUFACTURER'S RECOMMENDATIONS

- A. Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

1.15 DELIVERY AND STORAGE

- A. Refer to Division 01 for additional requirements.

- B. Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations and with the requirements of NFPA 70B P, Appendix I, titled "Equipment Storage and Maintenance During Construction." Replace damaged or defective items with new items.

1.16 GUARANTEE

- A. Except as may be specified under other sections in the Specifications, guarantee all equipment furnished under the Specifications for a period of one year from date of project acceptance against defective workmanship and material and improper installation. Upon notification of failure, correct deficiency immediately and without cost to the Owner.
- B. Standard warranty of manufacturer shall apply for replacement of parts after expiration of the above period. Manufacturer shall furnish replacement parts to the Owner for their service agency as directed.

1.17 COMMISSIONING

- A. Division 23 will be responsible to carry out the commissioning requirements specified in Section 230800, 019113 and other sections referenced in 019113.
- B. Management:
 - 1. The Commissioning Agent (CA) is hired directly by the Owner.
 - 2. The CA directs and coordinates the commissioning activities and the reports to the Owner's Representative.
 - 3. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.
 - 4. All contractors shall include the cost of commissioning in the contract price. The contractors should be prepared to provide commissioning assistance and follow through until all the commissioned systems have been signed off by the commissioning provider and the Owner Representative.
 - 5. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.
- C. Commissioning requires the participation of Division 23 Mechanical Contractor to work to ensure that all systems are operating in a manner consistent with the Design Intent.
 - 1. The general commissioning requirements and coordination are detailed in Division 1, Section 019113 General Commissioning Requirements and Division 23.
 - 2. This Division shall be familiar with all parts of Division 1 and Division 23 and the commissioning plan issued by the Commissioning Authority and shall execute all commissioning responsibilities assigned to them in the Contract Documents.
- D. The mechanical contractor is responsible for assisting the commissioning agent throughout the entire commissioning process. The work is not complete until the commissioning agent and the Owner Representative has signed off on the commissioned systems.

1.18 COMMISSIONING RESPONSIBILITIES

- A. Mechanical Contractor: The commissioning responsibilities applicable to the mechanical contractor are as follows (all references apply to commissioned equipment only):
1. All contractors shall include the cost of commissioning in the contract price. The contractors should be prepared to provide commissioning assistance and follow through until all the commissioned systems have been signed off by the commissioning provider and the Owner Representative.
 2. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.
 3. General Contractor shall attend a commissioning kickoff meeting and other meetings necessary to facilitate the commissioning process.
 4. General Contractor shall provide the Commissioning Provider with normal cut sheets and shop drawing submittals of commissioned equipment.
 5. General Contractor shall provide additional requested documentation, prior to normal O&M manual submittals, to the Commissioning Provider for development of start-up and functional testing procedures.
 - a. Typically, this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Provider.
 - b. The Commissioning Provider may request further documentation necessary for the commissioning process.
 6. General Contractor shall provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the Commissioning Provider for review.
 7. Sub-Contractors and design engineers shall assist in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
 8. General Contractor shall provide limited assistance to the Commissioning Provider in preparing the specific functional performance test procedures. Sub-Contractors shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
 9. General Contractor shall develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the pre-functional checklists from the Commissioning Provider for all commissioned equipment. Submit to Commissioning Provider for review prior to startup.
 10. During the startup and initial checkout process, execute the mechanical related portions of the pre-functional checklists for all commissioned equipment.
 11. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the Commissioning Provider.
 12. Address current Engineer of Record punch list items before functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air- or water-related systems.
 13. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem solving.

14. Provide skilled technicians to perform functional performance testing under the direction of the Commissioning Provider. Assist the Commissioning Provider in interpreting the monitoring data, as necessary.
 15. Correct deficiencies (differences between specified and observed performance) as interpreted by the Commissioning Provider, Owner's Representative and Engineer of Record and retest the equipment.
 16. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
 17. During construction, maintain as-built redline drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update after completion of commissioning.
 18. Provide training of the Owner Representative's operating staff using expert qualified personnel, as specified.
 19. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
 20. Execute any deferred functional performance testing, witnessed by the Commissioning Provider, according to the specifications.
 21. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.
- B. Mechanical Contractor. The responsibilities of the HVAC mechanical contractor, during construction and acceptance phases in addition to those listed in (A) are:
1. Provide startup for all HVAC equipment, except for the building automation control system.
 2. Assist and cooperate with the TAB contractor and Commissioning Provider by:
 - a. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.
 - b. Including cost of sheaves and belts that may be required by TAB.
 - c. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Provide an approved plug.
 - d. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.
 3. Install a P/T plug at each water sensor, which is an input point to the control system.
 4. List and clearly identify on the as-built drawings the locations of all air-flow stations.
 5. Prepare a preliminary schedule for pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the Commissioning Provider. Update the schedule as appropriate.
 6. Notify the Owner's Representative when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur. Be responsible to notify the Owner's Representative or Commissioning Provider, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the Commissioning Provider has the scheduling information needed to efficiently execute the commissioning process.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.1 GENERAL

- A. Obtain and pay for all permits and inspections, including any independent testing required to verify standard compliance, and deliver certificates for same to the Owner's Representative.

3.2 WORK RESPONSIBILITIES

- A. The drawings indicate diagrammatically the desired locations or arrangement of piping, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work to secure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference with structural conditions.
- B. The Contractor is responsible for the correct placing of Work and the proper location and connection of Work in relation to the work of other trades. Advise appropriate trade as to locations of access panels.
- C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes shall be made without extra cost, providing the change is ordered before the ductwork, piping, etc. and work directly connected to same is installed and no extra materials are required.
- D. Where equipment is furnished by others, verify dimensions and the correct locations of this equipment before proceeding with the roughing-in of connections.
- E. All scaled and figured dimensions are approximate of typical equipment of the class indicated. Before proceeding with any work, carefully check and verify all dimensions, sizes, etc. with the drawings to see that the equipment will fit into the spaces provided without violation of applicable codes.
- F. Should any changes to the Work indicated on the Drawings or described in the Specifications be necessary in order to comply with the above requirements, notify the Owner immediately and cease work on all parts of the contract, which are affected until approval for any required modifications to the construction has been obtained from the Owner.
- G. Be responsible for any cooperative work, which must be altered due to lack of proper supervision or failure to make proper provisions in time. Such changes shall be under direction of the Owner and shall be made to his satisfaction. Perform all Work with competent and skilled personnel.
- H. All work, including aesthetic as well as mechanical aspects of the Work, shall be of the highest quality consistent with the best practices of the trade.
- I. Replace or repair, without additional compensation, any Work, which, in the opinion of the Owner, does not comply with these requirements.

3.3 PAINTING

- A. Refer to Division 09 for additional requirements.
- B. Factory Applied:
 - 1. Mechanical equipment shall have factory-applied painting systems, which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test, except equipment specified to meet requirements of ANSI C37.20 shall have a finish as specified in ANSI C37.20.
 - 2. Refer to individual sections of this Division for more stringent requirements.
- C. Field Applied:
 - 1. Paint all mechanical equipment as required to touch up, to match finish on other equipment in adjacent spaces or to meet safety criteria.
 - 2. Paint all exposed, uninsulated mechanical piping, valves, supports, hangers and appurtenances. Provide minimum 5 mils dry film thickness.
 - 3. Paint ductwork flat black that are visible behind air outlets and inlets.
 - 4. Paint all exposed and rooftop ductwork, roof mounted mechanical equipment, ductwork supports, hangers and appurtenances.
 - 5. Paint shall be a high performance polyurethane enamel coating system.
 - a. Acceptable paint manufacturers include Ameron, Tnemec or engineer approved equal.
 - b. Acceptable primer manufacturers include Ameron Amershield VOC, Tnemec's Series 1075 (1074) Endura-Shield, semi-gloss (gloss) sheen or equal.
 - c. Provide minimum 5 mils dry film thickness.

3.4 COMMISSIONING TRAINING OF OWNER'S REPRESENTATIVE PERSONNEL

- A. The General Contractor shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.
- B. The Commissioning Provider shall be responsible for reviewing the content and adequacy of the training of Owner's Representative personnel for commissioned equipment.
- C. Mechanical Contractor. The mechanical contractor shall have the following training responsibilities:
 - 1. Provide the Commissioning Provider and A/E with a training plan at least two weeks before the planned training.
 - 2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment.
 - 3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
 - 4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 - 5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece

- of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.
6. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.
 7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
 8. Training shall include:
 - a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
 - b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.
 - c. Discussion of relevant health and safety issues and concerns.
 - d. Discussion of warranties and guarantees.
 - e. Common troubleshooting problems and solutions.
 - f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
 - g. Discussion of any peculiarities of equipment installation or operation.
 - h. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate.
 9. Hands-on training shall include start-up, operation in all modes possible, including manual, shutdown and any emergency procedures and preventative maintenance for all pieces of equipment.
 10. The mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.
 11. Training shall occur after functional testing is complete, unless approved otherwise by the Owner's Representative.

END OF SECTION 23 00 00

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SECTION 230500

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeves and seals.
 - 4. Escutcheons.
 - 5. Grout.
 - 6. HVAC demolition.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. Concrete bases.
 - 9. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Welding certificates.
- B. Product Information for approval before purchase
- C. Operation and Maintenance Manuals

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
- C. Pipe Flange Nuts and Bolts: Provide 304 stainless steel bolts, washers and nuts for mechanical rooms, underground piping and in humid areas.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.

- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 psig minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 150-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 150-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Stainless steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.
- E. Provide approved fireproof sleeve seals for penetrations of fire rated walls.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated

2.7 GROUT

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

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material. Patch any openings in floors, walls, or ceilings left by demoed piping.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material. Patch any openings in floors, walls, or ceilings left by demoed ductwork.
 - 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner. Patch any openings in floors, walls, or ceilings left by demoed equipment.

- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten

bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2" and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2" and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

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

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete "

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.9 GROUTING

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

END OF SECTION

SECTION 230513

COMMON MOTOR REQUIREMENTS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies alternating current induction motors, 250 horsepower or less, to be provided with the driven equipment. This section does not specify medium voltage (2300 volts and greater) motors and specialty motors. Unless specified otherwise, the manufacturer of the driven equipment shall provide electric motors. This section refers to motors by enclosure type as defined in NEMA MG 1, except as noted. All motors shall be the energy efficient type.

1.2 QUALITY ASSURANCE

- A. General: Motors shall be built in accordance with UL 674, UL 1104, NEMA Standard MG 1, and to the requirements specified.
- B. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

AFBMA 9	Load Ratings and Fatigue Life for Ball Bearings.
AFBMA 11	Load Ratings and Fatigue Life for Roller Bearings.
ANSI/IEEE 112	Polyphase Induction Motors and Generators.
NEMA ICS 2	Industrial Control Devices, Controllers and Assemblies.
NEMA ICS 6	Enclosures for Industrial Controls and Systems.
NEMA MG 1	Motors and Generators.
UL 674	Motors and Generators, Electric, for Use in Hazardous Locations, Class I, Groups C and D, Class II, Groups E, F & G.
UL 1004	Motors, Electric.

1.3 SUBMITTALS

- A. Submit the following:
1. Motor data shall be submitted for each item of motor-driven equipment to be provided under this Contract.
 2. Motor outline, dimensions, and weight.
 3. Manufacturer's general descriptive information relative to motor features.
 4. Where a winding over temperature device is required, provide a response curve for the temperature device.
 5. Operating and maintenance information.
 6. Operating and maintenance instructions for all motors within this specification.

1.4 AMBIENT CONDITIONS

- B. Unless specified otherwise, motors shall be suitable for continuous operation at an elevation of 1,000 feet above sea level. Motors to be installed outdoors, exposed to the weather, shall be suitable for continuous operation in a 40°C ambient temperature; motors to be installed indoors shall be suitable for continuous operation in a 40°C ambient temperature.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Motor nameplates shall be engraved or stamped stainless steel. Information shall include those items enumerated in NEMA Standard MG 1, paragraph 10.37, 10.38 or 20.60, as applicable.
- B. Additionally, nameplates for motors 1/2 horsepower and larger shall indicate the AFBMA L-10 rated life for the motor bearings. Nameplates for high efficiency motors shall list the nominal efficiency.
- C. Nameplates shall be permanently fastened to the motor frame and shall be positioned to be easily visible for inspection.

2.2 CONSTRUCTION

- A. Unless specified otherwise, all motors provided under this specification shall have the following features of construction:
 - 1. Cast iron or steel frames.
 - 2. Cast metal fan blades and shrouds.
 - 3. Stainless steel hardware.
 - 4. Non-hydroscopic leads.

2.3 MOTORS LESS THAN 1/2 HORSEPOWER

- A. General: Unless otherwise specified, motors less than 1/2 horsepower shall be squirrel cage, single phase, capacitor start, induction run type. Single phase motors shall have Class B insulation. Small fan motors may be split-phase or shaded pole type. Windings shall be copper.
- B. Rating: Unless specified otherwise, motors shall be rated for operation at 115 volts, single phase, 60 Hz, and shall be continuous-time rated in conformance with NEMA Standard MG 1, paragraph 10.35. Dual voltage (115/230) rated motors are acceptable if all leads are brought out to the conduit box. Motors shall be non-overloading at all points of the equipment.
- C. Enclosures: Unless otherwise specified, motors shall have totally enclosed fan-cooled enclosures.

2.4 MOTORS 1/2 HORSEPOWER THROUGH 250 HORSEPOWER

- A. General: Unless otherwise specified, motors 1/2 horsepower through 250 horsepower shall be 3 phase, squirrel cage, full voltage start induction type. Unless otherwise specified, motors shall have a NEMA MG 1-1.16 design letter B or C torque characteristic as required by the driven equipment's starting torque requirements.
- B. Rating:
 - 1. Unless otherwise specified, motors shall be rated for operation at 460 volts, 3 phase, 60 Hz, and shall be continuous time rated in accordance with NEMA standard MG 1, paragraph 10.35. Dual voltage (230/460) rated motors are acceptable if all leads are brought out to the conduit box. Unless specified otherwise, motors shall have a service factor of 1.15 and shall not be required to exceed its nameplate rating.
 - 2. Motors for variable frequency systems shall not be required to deliver more than 80 percent of the motor's service factor rating by any load imposed by the driven machine at any specified operating condition or any condition imposed by the driven machine's performance curve at maximum operating speed.
- C. Enclosure and Insulation:
 - 1. Temperature rise for all motor types shall not exceed that permitted by Note II, paragraph 12.42, NEMA MG 1. The insulation shall be non-hygroscopic.
 - 2. Unless otherwise specified in individual technical sections, all motors shall be open drip proof with Class F insulation. Motors rated 10 horsepower and larger shall have Class F insulation with Class B temperature rise. All internal surfaces shall be coated with an epoxy paint. Aluminum frame motors will not be permitted.
 - 3. Motors in moist applications shall be totally enclosed fan cooled (TEFC) with Class F insulation with Class B temperature rise. Fan motors in the air stream and downstream of the evaporative sections of the IDEC units will be TEFC.
 - 4. VFD applications shall have Class H insulation with Class B temperature rise.
- D. Energy-Efficient Motors: All motors shall be energy-efficient motors and shall be designed to comply with the minimum nameplate efficiency in paragraph 3.04 of this section. Motor efficiency shall be tested in accordance with IEEE-112, Test Method B with stray load loss adjustment as modified by NEMA MG 1-12.53 (a) and (b). Motor nameplate efficiency shall conform to the nominal values shown in NEMA MG 1, Table 12-6, and to the minimum acceptable efficiencies listed in Schedule A. Energy-efficient motors shall be U.S. Motors Premium Efficiency, Reliance Electric Duty Master XE, Baldor Super-E, or equal.
- E. Conduit Boxes: Conduit boxes shall be cast iron, split construction with threaded hubs. Conduit boxes shall be designed for rotation to permit installation in four positions at least 90 degrees apart. Motors shall be furnished with petroleum-resistant gaskets at the base of the conduit box and between the halves of the conduit box. Motors shall have a grounding lug located within the box for the ground connection.

- F. Bearings: Bearings may be oil or grease lubricated ball or angle contact roller bearings rated for a minimum L-10 life of 100,000 hours in accordance with AFBMA 9 or 11 at the ambient temperature specified herein. Motor designs employing cartridge type bearings will not be accepted. Bearings shall be fitted with lubricant fill and drain or relief fittings.
- G. Current Imbalance: Current imbalance shall not exceed the values tabulated below when the motor is operating at any load within its service factor rating and is supplied by a balanced voltage system:
 - 1. Under 5 horsepower: 25 percent.
 - 2. 5 horsepower and above: 10 percent.
- H. Special Features:
 - 1. General: Where specified or required by this paragraph, special features, as specified below, shall be provided.
 - 2. Heaters: Where specified, heaters shall be provided in motor enclosures to guard against condensation after shutdown. Heaters shall be cartridge or flexible wraparound type. Heaters shall be rated 120 volts, single phase, 60 Hz. The heater rating in watts and volts shall be noted on the motor nameplate or on a second nameplate. Space heater terminals shall be brought to a separate terminal block or pigtails in the conduit box.
- I. Motors for Variable Frequency Drives: Motors intended for use with variable frequency drives shall be compatible with the characteristics of the intended variable frequency generators. Motors shall be tested to IEEE Standard 112 test method B and NEMA MG 12.58.2 and 12.59 table 12-10. Motors shall be premium efficiency, inverter duty. Motors shall be designed to be installed at any distance from their respective variable frequency drives. Refer to specification section 23 05 14 for Variable Frequency Drive requirements.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Single phase motors for belted fans 1/20 HP to 1/3 HP: Split phase type.
- B. Single phase motors for shaft mounted fans or blowers 1/20 HP to 3/4 HP: Permanent split capacitor type.
- C. Single phase motors for pumps and air compressors 1/6 HP to 3/4 HP: Capacitor start type.
- D. Single phase motors for shaft mounted fans or blowers 1/3 HP to 3/4 HP: Capacitor start, capacitor run type.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.

3.3 NEMA OPEN MOTOR SERVICE FACTOR SCHEDULE

<u>HP</u>	<u>3600 RPM</u>	<u>1800 RPM</u>	<u>1200 RPM</u>
1/6-1/3	1.35	1.35	1.35
1/2	1.25	1.25	1.25
3/4	1.25	1.25	1.15
1-300	1.15	1.15	1.15

3.4 FULL LOAD MOTOR PERFORMANCE SCHEDULES

A. Three Phase - Premium Efficient, Open Drip-Proof

<u>HP</u>	<u>Full Load RPM</u>	<u>NEMA Frame</u>	<u>Nominal Percent Efficiency</u>	<u>Minimum Percent Power Factor</u>
3	1800	182T	89.5	80
5	1800	184T	89.5	85
7-1/2	1800	213T	91.0	84
10	1800	215T	91.7	86
15	1800	254T	93.0	82
20	1800	256T	93.0	86
25	1800	284TS	93.6	86
30	1800	286TS	94.1	86
40	1800	324TS	94.1	86
50	1800	326TS	94.5	86
60	1800	364T	95.0	86
5	3600	182T	86.5	86
7-1/2	3600	184T	88.5	89
10	3600	213T	89.5	90
15	3600	215T	90.2	91
20	3600	254T	91.0	91
25	3600	256T	91.7	91
30	3600	284TS	91.7	91
40	3600	286TS	92.4	91
50	3600	324TS	93.0	91
60	3600	326TS	93.6	91

B. Three Phase - Premium Efficient, Totally Enclosed, Fan Cooled

<u>HP</u>	<u>Full Load RPM</u>	<u>NEMA Frame</u>	<u>Nominal Percent Efficiency</u>	<u>Minimum Percent Power Factor</u>
1	1800	143T	85.5	65
1-1/2	1800	145T	86.5	75
2	1800	145T	86.5	75
3	1800	182T	89.5	83
5	1800	184T	89.5	86
7-1/2	1800	213T	91.7	86
10	1800	215T	91.7	87
15	1800	254T	92.4	85
20	1800	256T	93.0	84
25	1800	284T	93.6	84
30	1800	286T	93.6	83
40	1800	324T	94.1	83
50	1800	326T	94.5	83
60	1800	364T	95.0	83

END OF SECTION

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: This section specifies pipe and equipment hangers, brackets, and supports. Pipe supports shall be furnished complete with all necessary inserts, bolts, nuts, rods, washers and other accessories.
- B. Operating Conditions: The hangers and supports specified in this section are provided to resist pipe loads occurring primarily in the downward (gravity) direction. For the purpose of pipe hanger and support selection, this section establishes pipe support classifications based on the operating temperatures of the piping contents. Pipe support classifications are as follows:
 - 1. Cold Systems: 33°F to 59°F.
 - 2. Ambient Systems: 60°F to 119°F.
 - 3. Hot Systems: 120°F to 250°F.
- C. Hanger and Support Selection:
 - 1. In certain locations, pipe supports, anchors, and expansion joints have been indicated on the Drawings, but no attempt has been made to indicate every pipe support, anchor and expansion joint. It shall be the Contractor's responsibility to provide a complete system of pipe supports, to provide expansion joints, and to anchor all piping, in accordance with the requirements set forth herein. Additional pipe supports may be required adjacent to expansion joints, couplings, or valves.
 - 2. Concrete or fabricated steel and FRP supports shall be as indicated on the Drawings, as specified in other sections, or, in the absence of such requirements, as permitted by the University's representative.
 - 3. The Contractor shall select pipe hangers and supports as specified in this Section. Stock hanger and support components shall be used wherever practical. Selections shall be based upon the pipe support classifications specified in this Section; the piping insulation thickness specified in Section 23 07 00, and any special requirements, which may be specified in the Project Specification.
 - 4. The Contractor shall review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the type of support to be used at each hanger point.
 - 5. All piping shall be rigidly supported and anchored so there is no movement or visible sagging between supports.
 - 6. Hangers and supports shall withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected. As a minimum, consideration should be given to the following conditions:
 - a. Weights of pipe, valves, fittings, insulating materials, suspended hanger components, and normal fluid contents.
 - b. Weight of hydrostatic test fluid or cleaning fluid if normal operating fluid contents are lighter.
 - c. Reaction forces due to the operation of safety or relief valves.

- d. Wind loadings on outdoor piping.
7. Hangers and supports shall be sized to fit the outside diameter of pipe, tubing, or, where specified, indicated or required, the outside diameter of insulation.
8. Where negligible movement occurs at hanger locations, rod hangers should be used for suspended lines, wherever practical. For piping supported from below, bases, brackets or structural cross members should be used.
9. Hangers for the suspension of size 2-1/2 inches and larger pipe and tubing shall be capable of vertical hanger component adjustment under load.
10. The supporting systems shall provide for and control the free or intended movement of the piping including its movement in relation to that of connected equipment.
11. Where there is horizontal movement at a suspended type hanger location, hanger components shall be selected to allow for swing. The vertical angle of the hanger rod shall not, at any time, exceed 4 degrees.
12. There shall be no contact between a pipe and hanger or support component of dissimilar metals when supporting copper tubing by use of felt isolator inserts, rubber, plastic or vinyl coated, or felt lined hanger and support components.
13. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.
14. Unless otherwise specified, pipe support components shall not be attached to pressure vessels.
15. Plumber's tape shall not be used to support piping.

1.2 QUALITY ASSURANCE

- A. References: This section contains references to the following standards for manufacturer and installation requirements. They are a part of this section in their entirety or as specifically modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail. In case of conflict between the listed documents, the more stringent requirement shall prevail.

AISC M016	Manual of Steel Construction - 9th Edition
ASME B31.1	Power Piping
ASME B31.2	Fuel Gas Piping
ASME B31.9	Building Services Piping
ASTM E84	Surface Burning Characteristics of Building Materials, Test Method for
MSS SP58	Pipe Hangers and Supports - Materials, Design and Manufacturer.
MSS SP69	Pipe Hangers and Supports - Selection and Application.
NFPA 13	Installation of Sprinkler Systems.
NFPA 14	Installation of Standpipe and Hose Systems.
SMACNA	Seismic Restraint Manual Guidelines for Mechanical Systems.
UL 203	Pipe Hanger Equipment for Fire Protection Service

- B. Supports for Mechanical Systems and Plumbing Piping Systems: In conformance with MSS SP-58 and SP-69.

- C. Supports for Sprinkler Piping: In conformance with minimum requirements as established in NFPA 13.
- D. Supports for Standpipes: In conformance with minimum requirements as established in NFPA 14.

1.3 SUBMITTALS

- A. Submit the following:
 - 1. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
 - 2. Product Data: Provide manufacturers catalog data including load capacity.
 - 3. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. For every piece of material or equipment with an operating weight of 500 pounds or more, the Contractor shall submit a design support drawing prepared and sealed by a California Licensed Structural Engineer. All designs shall conform to 2007 CBC requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS

- A. Standard pipe supports and components shall be manufactured by B-Line, Carpenter & Patterson, Kin-Line, ITT Grinnell, Michigan, Pipe Shields Incorporated, Superstrut, Unistrut, Tolco, Piping Technology & Products, Inc. or equal.
- B. Plumbing Piping - DWV:
 - 1. Conform to ASME B31.9, MSS SP58 and MSS SP69.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, and split ring.
 - 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 - 6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.
 - 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 9. Copper Pipe Support: Carbon steel ring, adjustable, felt lined or vinyl coated.
- C. Plumbing Piping - Water:
 - 1. Conform to ASME B31.9, MSS SP58 and MSS SP69.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, and split ring.
 - 3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 - 4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.

5. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
 6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
 8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 9. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 10. Vertical Support: Steel riser clamp.
 11. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 12. Copper Pipe Support: Carbon steel ring, adjustable, felt lined or vinyl coated.
- D. Hydronic Piping:
1. Conform to ASME B31.9, MSS SP58 and MSS SP69.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring, and spring hanger.
 3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis, spring hanger.
 4. Hangers for Hot Pipe Sizes 2 to 6 Inches: Carbon steel, adjustable, roller, spring hanger.
 5. Hangers for Hot Pipe Sizes 6 Inches and Over: Not Used.
 6. Pipe Anchor:
 - a. Manufacturers:
 - 1) Piping Technology & Products, Inc.
 - 2) ITT Grinnell
 - 3) B-Line
 - 4) Or equal.
 - b. Factory fabricated, double saddle, welded construction, made of high strength carbon steel.
 - c. Anchor shall be capable of withstanding a deadweight (downward force) equivalent to the weight 28 feet of Sch.40 pipe filled with water of the pipe size it supports.
 - d. Provide with critical dimensions as indicated on the Drawings.
 - e. Anchors shall be degreased, and deburred, shop coat primed and ready for welding when delivered to the jobsite.
 - f. Pipe anchor shall be capable of withstanding a lateral seismic force equal to 0.6 times the deadweight force. Pipe anchor shall be capable of withstanding an axial thrust load equal to 1/2 of the deadweight force.
 7. Pipe Slide Support Assembly:
 - a. Manufacturers:
 - 1) Piping Technology & Products, Inc.
 - 2) ITT Grinnell
 - 3) B-Line
 - 4) Or equal.
 - b. Factory fabricated, (2) piece assembly, as indicated on the Drawings.

- c. Top piece shall consist of saddle support with double U-bolt hold down assembly. Assembly shall be completely factory fabricated and have slots for the four (4) hold down bolts of the bottom assembly. Slots shall be sized as follows:
 - 1) Chilled Water: Provisions for 3/4" slide, either direction along pipe axis.
 - 2) Refer to the front and side view shown on the drawings.
 - d. Assembly shall be capable of withstanding a downward deadweight force equal to the weight of 28 feet of Schedule 40 pipe filled with water of the pipe size it supports. Assembly shall also be capable of withstanding a lateral or tangential seismic horizontal force equal to 0.6 times the deadweight.
- 8. Pipe Guide Assembly:
 - a. Manufacturers:
 - 1) Piping Technology & Products, Inc.
 - 2) ITT Grinnell
 - 3) B-Line
 - 4) Or equal.
 - b. Factory fabricated, two (2) piece, welded construction, and made entirely of carbon steel.
 - c. Unit shall consist of retainer outer tube and spider slide/pipe clamp assembly.
 - d. Assembly shall be capable of withstanding a downward deadweight force equal to the weight of 28 feet of Schedule 40 pipe filled with water of the pipe size it supports. Assembly shall also be capable of withstanding a lateral or tangential seismic horizontal force equal to 0.6 times the deadweight.
- 9. Elbow Supports:
 - a. Welded steel pipe stand with steel base plate anchored and grouted to floor, seismic spring support and welded steel extension off pipe elbow. Use U-bolt cradle where support is below horizontal pipe; refer to the Drawings.
 - b. Spring shall have minimum 2" deflection.
- 10. Wall Support for Pipe Sizes to 4" shall be as indicated on the Drawings.

2.2 STRUCTURAL ATTACHMENTS

- A. Steel beam clamp with Eye Nut: Beam clamp and eye nut shall be forged steel. Configuration and components shall comply with MSS and FEDSPEC Type 28. Grinnell Fig. 292, Carpenter & Patterson Fig. 297, or equal.
- B. Welded Beam Attachment: Beam attachment shall be carbon steel and comply with MSS and FEDSPEC Type 22. B-Line B3083, Grinnell Fig. 66, or equal.
- C. Welded Steel Bracket: Bracket shall be carbon steel and comply with MSS Type 32 and FEDSPEC Type 33 for medium welded bracket shall comply with MSS Type 33 and FEDSPEC Type 34.
- D. Beam "C" Clamp with Locknut and Retaining Strap: Beam clamp and locknut shall be forged steel. Configuration and components shall comply with MSS and FEDSPEC Type 19. Tolco Fig. 65 or 66 with Fig. 69 retaining strap, B-Line B3036 with B3362 strap, or equal.
- E. Concrete Wall Attachment: Concrete wall attachments shall conform to SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.

2.3 ACCESSORIES

- A. Hanger Rods: Rods shall be carbon steel or 304 stainless steel, threaded on both ends or continuous threaded and sized as specified.
- B. Weldless Eye Nut: Eye nut shall be forged steel and shall comply with MSS and FEDSPEC Type 17. Eye nut shall be Grinnell Fig. 290, B-Line B2300, or equal.
- C. Welded Eye Rod: Eye rod shall be carbon steel with eye welded closed. Inside diameter of eye shall accommodate a bolt diameter 1 / 8 inch larger than the rod diameter. Eye rod shall be Grinnell Fig. 278, B-Line B2311, or equal.
- D. Turnbuckle: Turnbuckle shall be forged steel and shall comply with MSS and FEDSPEC Type 15. Turnbuckle shall be Grinnell Fig. 230, B-Line B2311, or equal.
- E. Metal Framing Channel: Framing channel shall conform to the Metal Framing Manufacturers Association Standard MFMA-1. Framing channel shall be 1-5/8 inches square, roll formed, and 12-gage carbon steel. Channel shall have a continuous slot along one side with intumed clamping ridges. Framing channel shall be Unistrut P-1000 series, Superstrut A-1200 series, or equal.
- F. Vinylester Resin Fiberglass Framing Channel: Framing channel shall conform to ASTM E84 and shall be Class 1 fire-rated. Framing channel shall be 1-5/8" square. All channels shall be supplied with integral notches at 1" on center. Notches shall be located on the interior flange to prevent stoppage of pipe clamps and fittings after installation. Seal exposed glass fibers at cuts with manufacturer's sealant. Framing channel shall be StruTech, Series 200, vinylester resin fiberglass or equal (no known equal).
- G. Thermal Pipe Hanger Shield: Thermal shields shall be provided at hanger, support and guide locations on pipe requiring insulation. The shield shall consist of an insulation layer encircling the entire circumference of the pipe and a steel jacket encircling the insulation layer and shall be as specified in Section 23 07 00. The thermal shield shall be the same thickness as the piping system insulation specified in Section 23 07 00. The vapor barrier shield shall be used for cold systems. Stainless steel band clamps shall be used where specified to ensure against slippage between the pipe wall and the thermal shield.

2.4 INSERTS:

- A. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

PART 3 - EXECUTION

3.1 INSERTS

- A. Provide inserts for placement in concrete formwork.

- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.2 PIPE HANGER AND SUPPORT LOCATIONS

- A. The Contractor shall locate hangers and supports as near as possible to concentrated loads such as valves, flanges, etc. Locate hangers, supports and accessories within the maximum span lengths specified in the project specifications to support continuous pipeline runs unaffected by concentrated loads.
- B. At least one hanger or support shall be located within 2 feet from a pipe change in direction.
- C. The Contractor shall locate hangers and supports to ensure that connections to equipment, tanks, etc., are substantially free from loads transmitted by the piping.
- D. Where piping is connected to equipment, a valve, piping assembly, etc. that will require removal for maintenance, the piping shall be supported in such a manner that temporary supports shall not be necessary for this procedure.
- E. Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.
- F. Support horizontal cast iron pipe within 18 inches of each joint.

3.3 INSTALLATION

- A. Welded and bolted attachments to the building structural steel shall be provided where required and shall be in accordance with the requirements of SMACNA Seismic Restraint Guide and AISC M016. Unless otherwise specified, there shall be no drilling or burning of holes in the building structural steel.
- B. Unless otherwise indicated, attachments to the building concrete shall be in accordance with the requirements of SMACNA Seismic Restraint Guide.
- C. Hanger components shall not be used for purposes other than, for which they were designed. They shall not be used for rigging and erection purposes.
- D. The Contractor shall install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.
- E. Embedded anchor bolts shall be used instead of concrete inserts for support installations in areas below water surface or normally subject to submerging.

- F. The Contractor shall install thermal pipe hanger shields on insulated piping at required locations during hanger and support installation. Butt joint connections to pipe insulation shall be made at the time of insulation installation in accordance with the manufacturer's recommendations.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide felt lined inserts for copper piping.
- J. Hanger and support components in contact with plastic or FRP pipe shall be free of burrs and sharp edges.
- K. Rollers shall roll freely without binding.
- L. Finished floor beneath pipe stand and framing channel post bases shall be roughed prior to grouting. Grout between base plate and floor shall be free of voids and foreign material.
- M. Base plates shall be cut and drilled to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.
- N. Plastic or rubber end caps shall be provided at the exposed ends of all framing channels that are located up to 7 feet above the floor.
- O. Prime coat all exposed steel hangers and supports. Refer to Section 09900 for finish painting. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- P. Unless otherwise indicated, exposed exterior steel pipe supports, channel, and clamps shall have hot dipped galvanized finish of minimum 1.50 ounces per square foot on each side in conformance with ASTM A123.
- Q. Welds on pipe supports, either interior or exterior shall be cleaned of flux and finished with a "zinc rich" primer.
- R. The Contractor shall adjust hangers and supports to obtain required pipe slope and elevation. Shims made of material that is compatible with the piping material may be used. Stanchions shall be adjusted prior to grouting their base plates.
- S. Beam clamps shall not be installed on piping greater than 8 inches in diameter. All beam clamps shall have beam clamp retaining straps.

3.4 EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, thickness as indicated on the Drawings and extending 6 inches beyond supported equipment.

- B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

- A. Provide flashing where indicated or necessary.
- B. Provide flexible flashing and metal counter flashing where ductwork penetrates weather or waterproofed walls, floors, and roofs.
- C. Flash vent and water pipes projecting 12 inches minimum above finished roof surface with lead flashing and cast iron counter flashing, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, seal per Drawing Details.
- D. Flash floor drains in floors with topping over finished areas with 6-lb. lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- E. Seal floor drains watertight to adjacent materials.
- F. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms installed in accordance with manufacturer's instructions for sound control.
- G. Adjust storm collars tight to pipe with bolts; calk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Extend sleeves through floors one inch above finished floor level. Calk sleeves.
- D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and calk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- E. Install chrome plated steel escutcheons at finished surfaces.

3.7 SUPPORT SCHEDULE

PIPE SIZE (Inches)	MAXIMUM SUPPORT SPACING (Feet)	HANGER ROD DIAMETER (Inches)

Steel (sched 40)

1/2	6	3/8
3/4 to 1	8	3/8
1-1/4 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 6	14	5/8

Copper Type L

1/2 to 3/4	5	3/8
1 to 1-1/4	6	3/8
1-1/2 to 2	8	3/8
2-1/2	9	1/2
3	10	1/2
4 to 6	12	5/8

C.I. No-Hub
and at Joints

1-1/2 to 2	8	3/8
2-1/2 to 3	8	1/2
4 to 6	8	5/8

END OF SECTION

SECTION 230593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This section includes testing, adjustment, and balancing of air systems, hydronic systems, measurement of final operating condition of HVAC systems, sound measurement of equipment operating conditions, and vibration measurement of equipment operating conditions.

1.2 QUALITY ASSURANCE

- A. References: This section contains references to the following standards for manufacturer and installation requirements. They are part of this section in their entirety or as specifically modified. In case of conflict between the requirements of this section and following listed documents, the requirements of this section shall prevail.

AABC	National Standards For Total System Balance.
ADC	Test Code For Grilles, Registers, And Diffusers.
NEBB	Procedural Standards For Testing, Adjusting, And Balancing Of Environmental Systems.

- B. Perform total system balance in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
- C. Independent Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum five years documented experience certified by AABC or NEBB.
- D. Perform Work under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Supervisor experienced in performance of this Work and licensed in the State of California.
- E. Sequencing:
 - 1. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

1.3 SUBMITTALS

- A. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.
- B. Field Reports: Submit under provisions of Division 01. Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- C. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.

- D. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for University's Representative and for inclusion in operating and maintenance manuals.
- E. Provide reports in binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating sensor locations.
- F. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.
- G. Test Reports: Indicate data on AABC National Standards for Total System Balance forms or NEBB forms. Forms shall contain information indicated in Schedules.

PART 2 - Products

Not Used.

PART 3 - EXECUTION

3.1 AGENCIES

- A. Associated Air Balance Council (AABC).
- B. National Environmental Balancing Bureau (NEBB).

3.2 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place.
 - 15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
- C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to University's Representative to facilitate spot checks during testing.
- B. Provide additional balancing devices as required.

3.4 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 5 percent of design.

3.5 ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the University's Representative.
- F. Check and adjust systems approximately six months after final acceptance and submit report.

3.6 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

3.7 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential and pressure differential.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.8 SCHEDULES

- A. Report Forms: Agency shall compile the following data as outlined below:
 - 1. Title Page:
 - a. Name of Testing, Adjusting, and Balancing Agency
 - b. Address of Testing, Adjusting, and Balancing Agency
 - c. Telephone number of Testing, Adjusting, and Balancing Agency
 - d. Project name
 - e. Project location
 - f. Project Architect
 - g. Project Engineer
 - h. Project Contractor
 - i. Project altitude
 - j. Report date
 - 2. Summary Comments:
 - 3. Design versus final performance
 - a. Notable characteristics of system
 - b. Description of systems operation sequence

- c. Summary of outdoor and exhaust flows to indicate amount of building pressurization
 - d. Nomenclature used throughout report
 - e. Test conditions
- 4. Instrument List:
 - a. Instrument
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Range
 - f. Calibration date
- 5. Electric Motors:
 - a. Manufacturer
 - b. Model/Frame
 - c. HP/BHP
 - d. Phase, voltage, amperage; nameplate, actual, no load
 - e. RPM
 - f. Service factor
 - g. Starter size, rating, heater elements
 - h. Sheave Make/Size/Bore
- 6. V-Belt Drive:
 - a. Identification/location
 - b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave diameter and RPM
 - f. Center to center distance, maximum, minimum, and actual
- 7. Pump Data:
 - a. Identification/number
 - b. Manufacturer
 - c. Size/model
 - d. Impeller
 - e. Service
 - f. Design flow rate, pressure drop, BHP
 - g. Actual flow rate, pressure drop, BHP
 - h. Discharge pressure
 - i. Suction pressure
 - j. Total operating head pressure
 - k. Shut off, discharge and suction pressures
 - l. Shut off, total head pressure
- 8. Air Moving Equipment
 - a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Arrangement/Class/Discharge
 - f. Air flow, specified and actual
 - g. Return air flow, specified and actual
 - h. Outside air flow, specified and actual
 - i. Total static pressure (total external), specified and actual
 - j. Inlet pressure
 - k. Discharge pressure
 - l. Sheave Make/Size/Bore

- m. Number of Belts/Make/Size
 - n. Fan RPM
- 9. Return Air/Outside Air Data:
 - a. Identification/location
 - b. Design air flow
 - c. Actual air flow
 - d. Design return air flow
 - e. Actual return air flow
 - f. Design outside air flow
 - g. Actual outside air flow
 - h. Return air temperature
 - i. Outside air temperature
 - j. Required mixed air temperature
 - k. Actual mixed air temperature
 - l. Design outside/return air ratio
 - m. Actual outside/return air ratio
- 10. Exhaust Fan Data:
 - a. Location/Identification
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Air flow, specified and actual
 - f. Total static pressure (total external), specified and actual
 - g. Inlet pressure
 - h. Discharge pressure
 - i. Sheave Make/Size/Bore
 - j. Number of Belts/Make/Size
 - k. Fan RPM
- 11. Duct Traverse:
 - a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - i. Air temperature
 - j. Air correction factor
- 12. Air Distribution Test Sheet:
 - a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Area factor
 - f. Design velocity
 - g. Design air flow
 - h. Test (final) velocity
 - i. Test (final) air flow
 - j. Percent of design air flow
- 13. Equipment Requiring Testing, Adjusting and Balancing:

Air Hydronic

<u>Equipment</u>	<u>Balance</u>	<u>Balance</u>
HVAC Pumps		X
Air Handling Units	X	X
Fan Coils	X	X
Exhaust Fans	X	
VAV Boxes	X	X
Air Inlets and Outlets	X	

END OF SECTION

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SECTION 230705

HVAC INSULATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies insulation used on ductwork and plenums.

1.2 QUALITY ASSURANCE

- A. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

ASC-A-7001C	Adhesive and Sealant Council Standards for Adhesives for Duct Liner.
ASTM C518	Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
ASTM C553	Mineral Fiber Blanket and Felt Insulation.
ASTM E96	Water Vapor Transmission of Materials.
SMACNA DCS	SMACNA Duct Construction Standards.
UL 723	Surface Burning Characteristics of Building Materials.

- B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with UL 723 and UL790.
- C. Applicator: Company specializing in performing the work of this section with minimum three years experience.
- D. Store insulation in original wrapping and protect from weather and construction traffic.
- E. Protect insulation against dirt, water, chemical, and mechanical damage.
- F. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- G. Maintain temperature during and after installation for minimum period of 24 hours.

1.3 SUBMITTALS

- A. Submit the following:
 - 1. Product Data: Provide product description, list of materials and thickness for each service, and locations.
 - 2. Samples: Submit two samples of any representative size illustrating each insulation type.

3. For each item submitted, indicate paragraph(s) of compliance in specifications.
4. Where multiple options/features exist for a product, indicate which options have been selected for the submitted product.

PART 2 - PRODUCTS

2.1 GLASS FIBER, FLEXIBLE (INDOOR APPLICATION)

- A. Manufacturers: Owens-Corning Fiberglass all-service faced duct wrap, Certainteed, Knauf, Manville or equal.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 1. 'K' ('Ksi') value : ASTM C518, 0.30 at 75°F.
 2. Maximum service temperature: 250°F.
 3. Maximum moisture absorption: <3% at 120°F.
 4. Density: 0.5 lb/cu ft.
- C. Vapor Barrier Jacket
 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 2. Moisture vapor transmission: ASTM E96; 0.02 perm.
 3. Secure with pressure sensitive tape.
- D. Vapor Barrier Tape
 1. Manufacturers: Owens-Corning or equal (no known equal).
 2. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- E. Tie Wire: Annealed steel, 16 gage.

2.2 GLASS FIBER DUCT LINER, FLEXIBLE

- A. Manufacturers: Owens-Corning Aeroflex Duct Liner, Certainteed, Knauf, Manville or equal.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
 1. 'K' ('Ksi') value : ASTM C518-70, 0.26 at 75°F.
 2. Maximum service temperature: 250°F.
 3. Density: 3.0 lb/cu ft.
 4. Maximum Velocity on Coated Air Side: 4,000 ft/min.
- C. Liner Fasteners: Galvanized steel with press-on head conforming to SMACNA.
- D. Adhesive:
 1. Manufacturers: Owens-Corning or equal (no known equal).
 2. Waterproof fire-retardant type conforming to ASC-A-7001C.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that ductwork has been tested before applying insulation materials.
- B. Verify surfaces are smooth, dry, clean, and free from dust, debris, or other loose materials. Surfaces must be dry before the application of the insulation.

3.2 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Deliver products to the job site in manufacturer's original sealed containers with seals and labels intact. All materials shall be stored at job site, in an enclosed space, protected from excessive heat and cold, in accordance with material manufacturers instructions.
- C. Insulated ductwork conveying air below ambient temperature:
 - 1. Provide insulation with vapor barrier jackets.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. The Contractor shall be responsible for providing and installing all protective covers, drops, and masking required to protect adjacent areas, equipment, utilities, parts, material, and other items from spills, mist, spray, etc.
- E. The Contractor shall be responsible for the removal of and repairing any damage caused by cleaning chemicals, gravel, dust, coating materials, etc. The contractor shall also be responsible for damage caused by workers, equipment, etc.

3.3 TOLERANCE

- A. Substituted insulation materials shall provide thermal resistance within 5 percent at same thermal conditions, as materials indicated.

3.4 FLEXIBLE GLASS FIBER DUCTWORK INSULATION SCHEDULE

<u>DUCTWORK</u>	<u>THICKNESS</u> <u>Inch</u>	<u>FINISH</u>
Indoor Supply Ducts in Non-Conditioned Spaces (delta T >15 deg F)	3"	Vapor Barrier
Indoor Return Ducts, in Non-Conditioned Spaces (delta T >15 deg F)	3"	Vapor Barrier
Indoor Supply Ducts In conditioned spaces (delta T < 15 deg F)	1"	Vapor Barrier

Indoor Return Ducts, 1" Vapor Barrier

In conditioned spaces ($\Delta T < 15 \text{ deg F}$)

3.5 GLASS FIBER DUCT LINER INSULATION SCHEDULE

	THICKNESS
<u>DUCTWORK</u>	<u>Inch</u>

All ducts shown lined on drawings	1.0

END OF SECTION

SECTION 230900 - DDC CONTROLS/BUILDING AUTOMATION CONTROL SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish a totally native BACnet-based system, based on a distributed control system in accordance with this specification. All building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135–2001, BACnet. In other words, all controllers, including unitary controllers, shall be native BACnet devices. The control system shall be Alerton to match existing Crafton Hills College Energy Management System.
- B. The controls system shall be manufactured by Alerton and installed by an authorized Alerton installer to match the Crafton Hills College standard, no exceptions or substitutions. Please see authorized Alerton Installers in section 1.4 (a).
- C. Provide all necessary BACnet-compliant hardware and software to meet the system's functional specifications. Provide Protocol Implementation Conformance Statement (PICS) for Windows-based control software and every controller in system, including unitary controllers.
- D. Prepare individual hardware layouts, interconnection drawings, and software configuration from project design data.
- E. Design, provide, and install all equipment cabinets, panels, data communication network cables needed, and all associated hardware.
- F. Provide and install all interconnecting cables between supplied cabinets, application controllers, and input/output devices.
- G. Provide and install all interconnecting cables between all operator's terminals and peripheral devices (such as printers, etc.) supplied under this section.
- H. Provide complete manufacturer's specifications for all items that are supplied. Include vendor name of every item supplied.
- I. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, and commissioning
- J. Provide a comprehensive operator and technician training program as described herein.
- K. Provide as-built documentation, software, diagrams, and all other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.
- L. Provide new sensors, valves, and install only new electronic actuators. No used components shall be used as any part or piece of installed system.

- M. Provide seamless connection to existing Alerton Control System. The new system shall be an extension of the existing Alerton Control System currently installed at Crafton Hills College. All new controllers and points shall be set-up, programmed, and downloaded from the existing Alerton Workstation utilizing Alerton Technologies, no exceptions.

1.2 SYSTEM DESCRIPTION

- A. A distributed logic control system complete with all software and hardware functions shall be provided and installed. System shall be completely based on ANSI/ASHRAE Standard 135-2010, BACnet. This system is to control all mechanical equipment, including all unitary equipment (VAV boxes, heat pumps, fan-coils, AC units, etc.), lighting control, and all air handlers, boilers, chillers, and any other listed equipment using BACnet-compliant components. Non-BACnet-compliant or proprietary equipment or systems (including gateways) shall not be acceptable and are specifically prohibited.
- B. Building controllers shall include complete energy management software, including scheduling building control strategies with optimum start and logging routines. All energy management software and firmware shall be resident in field hardware and shall not be dependent on the Master Network. Local operator's terminal software is to be used for access to field-based energy management functions only. Provide zone-by-zone direct digital logic control of space temperature, scheduling, runtime accumulation, equipment alarm reporting, and override timers for after-hours usage.
- C. All application controllers for every terminal unit (VAV, HP, UV, etc.) air handler, all central plant equipment, and any other piece of controlled equipment shall be fully programmable and communicate on a peer-to-peer basis. Application controllers shall be mounted next to controlled equipment and communicate with building controller via BACnet.
- D. All controllers shall be programmed with graphical logic programming tools. Line code programmed controllers are not allowed.
- E. Room sensors shall be provided with digital readout that allows the user to view room temperature, view outside air temperature, adjust the room setpoint within preset limits and set desired override time. User shall also be able to start and stop unit from the digital sensor. Include all necessary wiring and firmware such that room sensor includes field service mode. Field service mode shall allow technician to balance VAV zones and access any parameter in zone controller.

1.3 APPROVED MANUFACTURERS

- A. Only Alerton products may be installed for this Section of work.
- B. Only BTL approved equipment furnished by the above listed manufacturer will be acceptable. Products not BTL approved will be rejected. Any manufacturer other than the listed above are not acceptable, no exceptions or substitutions.

1.4 APPROVED INSTALLERS

- A. The following Alerton Dealer has been pre-qualified by the Crafton Hills College to execute this Section of work:
 - 1. Climatec Building Technologies Group
Contact Ryan Cheng at (949-394-1865)
 - 2. Campus approved equal.
- B. Only pre-qualified contractors approved by the owner will be acceptable. Any installer other than the listed above are not acceptable, no exceptions.
- C. The installing company must have performed building automation work at the Crafton Hills College prior to this project. Proof of project or work must be provided upon request.
- D. The approved installer must be an authorized Alerton dealer for Southern California. Authorized dealers from other regions are not acceptable.

1.5 QUALITY ASSURANCE

- A. Responsibility: The supplier of the FMCS shall be responsible for inspection and Quality Assurance (QA) for all materials and workmanship furnished.
- B. Component Testing: Maximum reliability shall be achieved through extensive use of high-quality, pre-tested components. Each and every controller, sensor, and all other DDC components shall be individually tested by the manufacturer prior to shipment.
- C. Tools, Testing and Calibration Equipment: The EMCS supplier shall provide all tools, testing, and calibration equipment necessary to ensure reliability and accuracy of the system.
- D. The systems control manufacturer shall have been an established manufacturer of BACnet protocol systems for a minimum of fifteen years.
- E. Control system shall be engineered, programmed and supported completely by representative's local office that must be within 70 miles of project site. The control contractor shall be independent; and shall not be a subsidiary or affiliated with a Mechanical Contractor.
- F. Prior to receiving approval to proceed on this project the contractor must provide and demonstrate the following:
 - 1. Ten (10) customer references in Los Angeles County with installed native BACnet Alerton systems as specified for this project.
 - 2. Five (5) large project references in the Southwestern United States with installed native BACnet Alerton systems as specified for this project. Projects must have been completed within the last (3) years.
 - 3. Reference Information must include the following:
 - a. Customer name
 - b. Address
 - c. Contact name

- d. Contact phone number
- e. System description
- f. Statement of BACnet compliance

1.6 PROJECT MANAGEMENT

- A. Have present at the project site, a project manager who shall, as a part of their duties, be responsible for the following activities:
 - 1. Coordination between the Subcontractor and all other trades, Owner, Local Authorities, and design team.
 - 2. Coordination of all activities between his subcontractors.
 - 3. Attendance at subcontractor/general contractor meetings.
 - 4. Scheduling of work progress, manpower loading, material delivery, equipment installation and checkout.
 - 5. Coordination of all drawings and submittals between consultants, engineers, other sub-trades and his subcontractors.
 - 6. Supervision of field technicians and interface with other trades.

1.7 REFERENCE STANDARDS

- A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
 - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
 - 2. ANSI/ASHRAE Standard 135-2010, BACnet.
 - 3. Uniform Building Code (UBC), including local amendments.
 - 4. UL 916 Underwriters Laboratories Standard for Energy Management Equipment. Canada and the US.
 - 5. National Electrical Code (NEC).
 - 6. FCC Part 15, Subpart J, Class A.
 - 7. EMC Directive 89/336/EEC (European CE Mark)
 - 8. City, county, state, and federal regulations and codes in effect as of contract date.
- B. Except as otherwise indicated the system supplier shall secure and pay for all permits, inspections, and certifications required for his work and arrange for necessary approvals by the governing authorities.

1.8 SUBMITTALS

- A. Drawings:
 - 1. The system supplier shall submit engineered drawings, control sequence, and bill of materials for approval.
 - 2. Drawings shall be submitted in the following standard sizes: 11" x 17" (ANSI B).
 - 3. Eight complete sets (copies) of submittal drawings shall be provided.

4. Drawings shall be available on CD-ROM.

B. System Documentation: Include the following in submittal package:

1. System configuration diagrams in simplified block format
2. All input/output object listings and an alarm point summary listing.
3. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
4. Complete bill of materials, valve schedule and damper schedule.
5. Manufacturer's instructions and drawings for installation, maintenance, and operation of all purchased items.
6. Overall system operation and maintenance instructions—including preventive maintenance and troubleshooting instructions.
7. For all system elements—building controller(s), application controllers, routers, and repeaters,—provide BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ASHRAE Standard 135-2010.
8. A list of all functions available and a sample of function block programming that shall be part of delivered system.

C. Project Management: The vendor shall provide a detailed project design and installation schedule with time markings and details for hardware items and software development phases. Schedule shall show all the target dates for transmission of project information and documents and shall indicate timing and dates for system installation, debugging, and commissioning.

1.9 WARRANTY

- A. Warranty shall cover all costs for parts, labor, associated travel, and expenses for a period of one year from completion of system acceptance.
- B. Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours Monday through Friday, 48 hours on Saturday and Sunday.
- C. This warranty shall apply equally to both hardware and software.

1.10 RELATED WORK IN OTHER SECTIONS

- A. Refer to Division 0 and Division 1 for related contractual requirements
- B. Refer to the following sections:
 1. Section 15122 “Meters and Gages for HVAC Piping” measuring equipment that relates to this Section.
 2. Section 15985 “Sequence of Operations for HVAC Controls” for requirements that relate to this Section.

PART 2 - PRODUCTS

2.1 OPERATOR'S WORKSTATION

- A. Integrate with existing Alerton Envision for BACTalk Operator Workstation in facility manager's office. Provide programming and software implementation to seamlessly integrate all controls provided in this project into the existing Alerton Envision server software
- B. The Alerton Envision server shall be able to download and upload programming into all field controllers provided in this project over the BMS network.
- C. Provide the latest software revisions or upgrades as needed to keep the existing workstation up to date.

2.2 BUILDING CONTROLLER

- A. General Requirements:
 - 1. BACnet Conformance
 - a. Building Controller shall be approved by the BTL as meeting the BACnet Building Controller requirements.
 - b. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 - 2. Building controller shall be of scalable design such that the number of trunks and protocols may be selected to fit the specific requirements of a given project.
 - 3. The controller shall be capable of panel-mounted on DIN rail and/or mounting screws.
 - 4. The controller shall be capable of providing global control strategies for the system based on information from any objects in the system, regardless if the object is directly monitored by the building controller module or by another controller.
 - 5. The controller shall be capable of running up to six (6) independent control strategies simultaneously. The modification of one control strategy does not interrupt the function or runtime others.
 - 6. The software program implementing the DDC strategies shall be completely flexible and user-definable. All software tools necessary for programming shall be provided as part of project software. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site, using a wide area network (WAN) or downloaded through remote communications are not acceptable. Changing global strategies using firmware changes is also unacceptable.
 - 7. Programming shall be object-oriented using control function blocks and support DDC

functions. All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be supplied and be resident on workstation. The same tool shall be used for all controllers.

8. The programming tool shall provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed using the operator's workstation or field computer.
9. Controller shall have 6,000 Analog Values and 6,000 Binary Values.
10. Controller IP configuration can be done via a direct USB connect with an operator's workstation or field computer.
11. Controller shall have at a minimum a Quad Core 996Ghz processor to ensure fast processing speeds.
12. Global control algorithms and automated control functions shall execute using a 64-bit processor.
13. Controller shall have a minimum of 1 GB of DDR3 SDRAM on a 533Mhz bus to ensure high speed data recording, large data storage capacity and reliability.
14. Controller shall support two (2) on-board EIA-485 ports capable of supporting various EIA-485 protocols including, but not limited to BACnet MS/TP and Modbus.
 - a. Ports are capable of supporting various EIA-485 protocols including, but not limited to BACnet MS/TP and Modbus.
15. Controller shall support two (2) ports—each of gigabit speed—Ethernet (10/100/1000) ports.
 - a. Ports are capable of supporting various Ethernet protocols including, but not limited to BACnet IP, FOX, and Modbus.
16. All ports shall be capable of having protocol(s) assigned to utilize the port's physical connection.
17. The controller shall have at a minimum four (4) onboard inputs, two (2) universal inputs and two (2) binary inputs.
18. Schedules
 - a. Building controller modules shall provide normal seven-day scheduling, holiday scheduling and event scheduling.
 - b. Each building controller shall support a minimum of 380 BACnet Schedule Objects and 380 BACnet Calendar Objects.
19. Logging Capabilities
 - a. Each building controller shall log as minimum 2,000 objects at 15-minute intervals. Any object in the system (real or calculated) may be logged. Sample time interval

shall be adjustable at the operator's workstation.

- b. Logs may be viewed both on-site or off-site using WAN or remote communication.
- c. Building controller shall periodically upload trended data to networked operator's workstation for long-term archiving if desired.
- d. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs.

20. Alarm Generation

- a. Alarms may be generated within the system for any object change of value or state (either real or calculated). This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
- b. Each alarm may be dialed out as noted elsewhere.
- c. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site using remote communications.
- d. Controller must be able to handle up to 2,000 alarm setups stored as BACnet event enrollment objects, with system destination and actions individually configurable.

21. Demand Limiting

- a. Demand limiting of energy shall be a built-in, user-configurable function. Each controller module shall support shedding of up to 1,200 loads using a minimum of two types of shed programs.
- b. Load shedding programs in building controller modules shall operate as defined in section 2.1.J of this specification.

B. BACnet MS/TP

- 1. BACnet MS/TP LAN must be software-configurable from 9.6 to 115.4Kbps
 - a. Each BACnet MS/TP LAN shall support 64 BACnet devices at a minimum.
 - b. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

C. BACnet IP

- 1. The building controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the local area network (LAN).
- 2. Must support interoperability on WANs and campus area networks (CANs), and function as a BACnet Broadcast Management Device (BBMD).

3. Each controller shall support at a minimum 128 BBMD entries.
4. BBMD management architecture shall support 3,000 subnets at a minimum.
5. Shall support BACnet Network Address Translation.
5. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

D. Expansion Ports

1. Controller shall support two (2) expansion ports.
 - a. Combining the two on-board EIA-458 ports with fully loaded expansion ports, the controller shall support six (6) EIA-485 trunks simultaneously.
2. Expansion cards that mate to the expansion ports shall include:
 - a. Dual port EIA-485 card.
 - b. LON network card.

E. Power Supply

1. Input for power shall accept between 17 and 30VAC, 47 and 63Hz.
2. Optional rechargeable battery for shutdown of controller including storage of all data in flash memory.
3. On-board capacitor will ensure continuous operation of real-time clocks for minimum of 14 days.

F. Controller shall be in compliance with the following:

1. UL 916 for open energy management
2. FCC Class B
3. ROHS
4. IEC 60703
5. C-Tick Listed

G. Controller shall operate in the following environmental conditions:

1. -4 to 149 °F (-20 to 65 °C) without optional battery, or 32 to 122 °F (0 to 50 °C) with optional battery.
2. 0 to 95% relative humidity (RH), non-condensing.

2.3 CENTRAL PLANT AND AIR HANDLING UNIT CONTROLLERS

A. General:

1. Central plant and Air Handling Unit controllers shall be the Alerton VLX Platinum expandable application controller. It shall be capable of providing control strategies for the system based on information from any or all connected inputs. The program that implements these strategies shall be completely flexible and user definable. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site via simple download are not acceptable. Changing global strategies via firmware changes is also unacceptable. Program execution of controller shall be a minimum of once per second.
2. Programming shall be object-oriented using control program blocks. Controller shall support a minimum of 500 Analog Values and 500 Binary Values. Each and every analog and binary value shall support standard BACnet priority arrays. Programming tool shall be provided with system and shall be the same tool that is used to program the Building Controller. All flowcharts shall be generated and automatically downloaded to controller. No re-entry of database information shall be necessary.
3. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed via the operator's terminal or field computer.
4. Controller shall have adequate data storage to ensure high performance and data reliability. Battery shall retain static RAM memory and real-time clock functions for a minimum of 1.5 years (cumulative). Battery shall be a field-replaceable (non-rechargeable) lithium type. Unused battery life shall be 10 years.
5. The onboard, battery-backed real time clock must support schedule operations and trend logs.
6. Global control algorithms and automated control functions should execute via 32-bit processor.
7. Controller shall include both on-board 10BASE-T/100BASE-TX Ethernet BACnet communication over twisted pair cable (UTP) and shall include BACnet IP communication. In addition, controller shall include BACnet PTP connection port.
8. The base unit of the controller shall host up to 8 expansion modules with various I/O combinations. These inputs and outputs shall include universal 12-bit inputs, binary triac outputs, and 8-bit switch selectable analog outputs (0-10V or 0-20 mA). Inputs shall support 3K and 10K thermistors, 0-5VDC, 0-10VDC, 4-20mA, dry contacts and pulse inputs directly.
9. All outputs must have onboard Hand-Off-Auto switches and a status indicator light. HOA switch position shall be monitored. Each analog output shall include a potentiometer for manually adjusting the output when the HOA switch is in the Hand position.
10. The position of each and every HOA switch shall be available system wide as a BACnet object. Expandable Central Plant Controller shall provide up to 176 discreet inputs/outputs per base unit.

B. BACnet Conformance:

1. Central Plant/AHU Controller shall as a minimum support Point-to-Point (PTP), MS/TP and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs

as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Building controller shall be a BACnet conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:

- a. Clock Functional Group
 - b. Files Functional Group
 - c. Reinitialize Functional Group
 - d. Device Communications Functional Group
 - e. Event Initiation Functional Group
 2. Please refer to section 22.2, BACnet Functional Groups, in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All necessary tools shall be supplied for working with proprietary information.
 3. Standard BACnet object types supported shall include as a minimum: Analog Input, Binary Input, Analog Output, Binary Output, Analog Value, Binary Value, Device, File, Group, Event Enrollment, Notification Class, Program and Schedule object types. All necessary tools shall be supplied for working with proprietary information.
 4. The Controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs) and function as a BACnet Broadcast Management Device (BBMD).
- C. Schedules: Each Central Plant/AHU controller shall support a minimum of 50 BACnet Schedule Objects.
- D. Logging Capabilities:
1. Each controller shall support a minimum of 200 trend logs. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
 2. Controller shall periodically upload trended data to system server for long term archiving if desired.
 3. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs
- E. Alarm Generation:
1. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
 2. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site via remote communications
 3. Controller must be able to handle up to 200 alarm setups stored as BACnet event enrollment objects – system destination and actions individually configurable.

2.4 TERMINAL UNIT APPLICATION CONTROLLERS (Heat Pumps, AC Units, Fan Coils)

- A. Provide one native BACnet application controller for each piece of unitary mechanical equipment that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.
- B. BACnet Conformance:
 - 1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
 - a. Files Functional Group
 - b. Reinitialize Functional Group
 - c. Device Communications Functional Group
 - 2. Please refer to Section 22.2, BACnet Functional Groups in the BACnet standard for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 - 3. Standard BACnet object types supported shall include as a minimum—Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- C. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5 VDC, 4–20 mA, dry contact signals and a minimum of 3 pulse inputs. Any input on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor. Controller shall include binary outputs on board with analog outputs as needed.
- D. All program sequences shall be stored on board controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using same programming tools as building controller and as described in operator workstation section. All programming tools shall be provided and installed as part of system.
- E. Application controller shall include support for intelligent room sensor (see Section 2.9.B.) Display on room sensor shall be programmable at controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.

2.5 TERMINAL BOX CONTROLLERS—SINGLE DUCT

- A. Provide one native BACnet application controller for each terminal box that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include on board CFM flow sensor, inputs, outputs and programmable, self-contained logic program as needed for control of units.
- B. All VAV controllers shall be the Alerton VAV-SD2A controller.
- C. BACnet Conformance
 - 1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
 - a. Files Functional Group
 - b. Reinitialize Functional Group
 - c. Device Communications Functional Group
 - 2. Please refer to Section 22.2, BACnet Functional Groups, in the BACnet standard, for a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
 - 3. Standard BACnet object types supported shall include as a minimum—Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- D. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5 VDC, and dry contact signals. Inputs on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall also include binary outputs on board. For applications using variable speed parallel fans, provide a single analog output selectable for 0-10 V or 0-20 mA control signals. Application controller shall include microprocessor driven flow sensor for use in pressure independent control logic. All boxes shall be controlled using pressure independent control algorithms and all flow readings shall be in CFM (LPS if metric).
- E. All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using the same programming tool as Building Controller and as

described in operator workstation section. All programming tools shall be provided as part of system.

- F. Application controller shall include support for intelligent room sensor (see Section 2.9.B.) Display on room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence for specific display requirements for intelligent room sensor.
- G. On board flow sensor shall be microprocessor driven and pre-calibrated at the factory. Pre-calibration shall be at 16 flow points as a minimum. All factory calibration data shall be stored in EEPROM. Calibration data shall be field adjustable to compensate for variations in terminal box type and installation. All calibration parameters shall be adjustable through intelligent room sensor. Operator workstation, portable computers and special hand-held field tools shall not be needed for field calibration.
- H. Provide duct temperature sensor at discharge of each terminal box that is connected to controller for reporting back to operator workstation.

2.6 DASHBOARD INTERFACE

- A. General: BAS supplier shall extend the existing campus Climatec AXCESS Dashboard to include this building. Update the existing dashboard system with the latest security patches and software revision.
- B. Information Display
 - 1. The web-based dashboard information screens shall:
 - a. Support displaying up to 50 buildings
 - b. User shall be able to navigate by clicking on icons and/ or navigate via a touchscreen without the need for any additional configuration.
 - c. The dashboard shall support auto rotation of pages to support display with no user interface (for example, touchscreen, mouse or keyboard). The pages to be displayed can be selected as a subset of all possible pages in the dashboard. The time to view each page and the order in the pages are cycled through shall be configurable.
 - d. The dashboard application shall include the following pages at a minimum:
 - 1) Home page
 - 2) Consumption page
 - 3) Summary page
 - 4) Demand page
 - 5) Green facts page
 - 6) Weather page
 - e. The end user shall be able to compare measured data for one (1) entity against measured data for a second entity.

- f. For each resource that is defined (e.g. water, gas, etc.) one (1) consumption page shall be used.
- g. The end user shall be able to view current data on one of the following time scales:
 - 1) Cumulative data for today, displayed in hour increments.
 - 2) Cumulative data for the current week, displayed in daily increments
 - 3) Cumulative data for the current month, displayed in daily increments
 - 4) Cumulative data for the current year, displayed in monthly increments
- h. The user shall be able to see:
 - 1) Today's data compared against the data for the same day last week.
 - 2) This week's data compared against the data for the same week last year.
 - 3) This month's data compared against the data for the same month last year.
 - 4) This year's data compared against the data for last year.
- i. The end user shall be able to view historical data in one of the following time scales:
 - 1) Complete data for yesterday, displayed in hour increments
 - 2) Complete data for last week, displayed in daily increments
 - 3) Complete data for last month, displayed in daily increments
 - 4) Complete data for last year, displayed in monthly increments.

C. Dashboard Data

- 1. The database for the dashboard must be on the enterprise network and remotely hosted on a third-party network. The database should be on-site to maintain security and privacy.
- 2. Energy Dashboard data shall reside on site and shall remain in the BAS.
- 3. The dashboard shall support Microsoft SQL database.
- 4. The dashboard shall allow for the importation of external data via CSV file format.

D. Browser Technology

- 1. The following browsers shall be supported:
 - a. Microsoft Internet Explorer v9.0 or later
 - b. Firefox 3.6.15
 - c. Safari 4
 - d. Google Chrome

E. Dashboard Licensing

- 1. The Energy Dashboard shall utilize software licensing that will run in perpetuity, without the need for additional service and/ or subscription fees.

F. Configuration

- 1. End users shall be able to connect remotely (including dashboard location) to the system to make changes to the configuration using a browser.

2. Energy Dashboard shall be maintainable by end-user staff with limited training and support common image files including JPEG and PNG.
3. User generated/ supplied content to include foreground images, background images, text, and icons.
4. Consumption pages for the resources defined – one (1) for each resource type for which he wishes to display consumption data. Consumption data is the total amount of a resource used over time, for example this is a kWh reading.
5. The system designer shall be able to configure:
 - a. One or more home pages.
 - b. One or more summary consumption pages. This page shows the total consumption for each configured entity within the system and a total for the entire enterprise.
 - c. One or more current demand pages. This page shows the current demand for a given entity.
 - d. One or more weather pages using weather station data from either NOAA or Google.
 - e. One or more green facts pages. This page is intended to inform the user of relevant environmental information. It is expected that this type of display will be used in relation to LEED certification.
6. Support ability to add additional capacity (more buildings, more meters) without the need for additional hardware.

G. Security

1. Dashboard Ability to restrict data behind a firewall or within a DMZ.
2. Dashboard application shall no allow the user to update the system data. For example, the user shall not be allowed to update the present-value of an analog value.
3. The dashboard shall require a user authorization via user name and password to access the configuration screens.

2.7 SENSORS and MISCELLANEOUS DEVICES

A. Temperature Sensors:

1. All temperature sensors to be solid state electronic, factory-calibrated to within 0.5°F, totally interchangeable with housing appropriate for application. Wall sensors to be installed as indicated on drawings. Duct sensors to be installed such that the sensing element is in the main air stream. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.

B. Thermowells:

1. Thermowells shall be pressure rated and constructed in accordance with the system working pressure. Thermowells and sensors shall be mounted in a threadolet or ½” NPT saddle and allow easy access to the sensor for repair or replacement. They shall be

constructed of machined stainless steel, type 316. Manufacturer shall be BAPI Model BA/4" M316 or Engineer approved equal.

C. Averaging Duct Type Temperature Sensors:

1. BAPI or Engineer approved equal.
 - a. Operating Temperature: -40 to 240°F
 - b. Sensing Element: NTC 10K (Type II) Thermistor
 - c. Accuracy: +/- 1°F.
2. Averaging duct temperature sensors with multiple sensing points shall be installed in ductwork that has a dimension greater than 48 inches and where air temperature stratification exists. Install complete with end cap, compression fittings, gaskets, mounting flange, and required accessories. Provide capillary supports at the sides of the duct to support the sensing string.

D. Liquid Immersion Temperature Sensors:

1. BAPI Model BA/10K or Engineer approved equal.
 - a. Operating Temperature: -40 to 240°F
 - b. Sensing Element: NTC 10K (Type II) Thermistor
 - c. Accuracy at Calibration Temperature: +/- 1°F.
2. All sensors measuring temperatures in pipes larger than 2 inches in diameter or in pressure vessels shall be supplied with wells properly fabricated for the service. Wells shall be non-corrosive to the medium being measured and shall have sufficient physical strength to withstand pressures and velocities to which they are subjected. Wells shall be installed in the piping at elbows where piping is smaller than the length of the well to affect proper flow across the entire area of the well.
3. Stainless steel, Type 304, socket with minimum insertion length of 4 inches.

E. Duct Type Temperature Sensors:

1. BAPI or Engineer approved equal.
 - a. Operating Temperature: -40 to 240°F
 - b. Sensing Element: NTC 10K (Type II) Thermistor
 - c. Accuracy at Calibration Temperature: +/- 1°F.
2. Sensors in ducts shall be mounted in locations to sense the correct temperature of the air only and shall not be located in dead air spaces, in close proximity to coils so as to display inaccurate temperatures, or positions obstructed by ducts, equipment, and so forth. Locations where installed shall be within the vibration and velocity limit of the sensing element.
3. Duct mount sensors shall mount in an electronic box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement. A neoprene grommet (Seal-lite fitting and mounting plate) shall be used on the sensor assembly to prevent air leaks.

4. Duct sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate. Duct sensors probe shall be constructed of 304/316 stainless steel.
5. Duct sensors shall not be mounted within 36 inches of heating and cooling coils.
6. For outdoor air duct applications, use a weatherproof mounting box with weatherproof cover and gasket.

F. Outdoor Air Temperature and Humidity:

1. Vaisala HUMICAP Outdoor Humidity and Temperature Transmitter HMD60YO or Engineer approved equal.
 - a. Humidity Operating Range: 0-100% RH
 - b. Humidity Output Signal: 4 to 20mA, 0 to 100% linear, proportional
 - c. Humidity Accuracy: +/- 2.0% RH, 0-90% RH.
 - d. Humidity Sensing Element: HUMICAP 180
 - e. Temperature Range: -40 to 140°F
 - f. Temperature Output Signal: 4 to 20mA, 0 to 100% linear, proportional
 - g. Temperature Accuracy: +/- 0.36°F
 - h. Sensing Element: 1K-ohm Platinum RTD 1/3 Class B IEC 751
2. Outdoor installations shall be of weatherproof construction or in appropriate NEMA enclosures. These installations shall be protected from solar radiation and wind effects. They shall also be provided with a solar radiation shield.

G. Intelligent Room Sensor with Touchscreen:

1. Hardware
 - a. Room sensor shall include:
 - i. Backlit touchscreen LCD digital display
 - ii. Temperature sensor
 - iii. Humidity sensor
 - iv. Programmable Status Light indicator
 - b. Temperature sensor shall be a Uni-Curve Type II thermistor with an accuracy of +/- 0.36 °F (0.3 °C) at calibration point over the range of 32 to 158 °F or better.
 - c. Humidity sensor shall have an accuracy of +/-3% from 10 to 90% relative humidity (RH) or better, non-condensing.
 - d. The intelligent room sensor's Status Light indicator shall have a minimum of four (4) colors (blue, red, amber and green) that will cast a glow onto the wall below the sensor to be used as visual indicator to the occupants of the condition of the system. The color and on/off state of the Status Light indicator shall be fully programmable.
 - e. The user shall interact with the smart sensor using a touchscreen, with no buttons allowed.

- f. The intelligent room sensor shall have provisions for a tamper proof installation requiring tools to be removed from the wall.
- g. The touchscreen shall have a surface hardness of Mohs 7 or greater to prevent being easily scratched.
- h. Controller shall function as room control unit, and allow occupant to raise and lower setpoint, and activate terminal unit for override use—all within limits as programmed by building operator.

2. Display Content

- a. The intelligent room sensor shall simultaneously display room setpoint, room temperature, and outside temperature at each controller.
- b. The intelligent room sensor shall have the ability to add or remove from the display time-of-day, room humidity, and indoor air temperature to customize the view for the customer.
- c. The intelligent room sensor must have the capability to show temperatures in degrees Fahrenheit or degrees Celsius.
- d. A communication loss or improper communications wiring shall be displayed on the LCD screen to aid in trouble shooting.
- e. Information about the version of firmware shall be displayable on the LCD screen.
- f. A cleaning mode will be provided to allow for the touchscreen to be cleaned without inadvertently making changes to system parameters.
- g. The intelligent room sensor shall have the ability to display the status of a lighting zone and control the on/off state of the zone from the touchscreen using a tenant-accessible display page.
- h. The intelligent room sensor shall have the ability to display the status of a window zone (e.g., blinds) and control the on/off state of the zone from the touchscreen using a tenant-accessible display page.
- i. After Hours Override shall:
 - i. Override time may be set and viewed in 30-minute increments.
 - ii. Override time countdown shall be automatic, but may be reset to zero by occupant from the sensor.
 - iii. Time remaining shall be displayed.
 - iv. Display shall show the word “OFF” in unoccupied mode unless a function button is pressed.

3. Other Modes

- a. The intelligent room sensor shall also allow service technician access to hidden functions for advanced system configuration. This functionality shall be accessed-protected with a configurable PIN number.
 - b. Field Service Mode shall allow access to common parameters as dictated by the application's sequence of operations. The parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.
 - c. If the intelligent room sensor is connected to VAV controller, Balance Mode shall allow a VAV box to be balanced and all air flow parameters viewed. The balancing parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.
4. Intelligent Room Sensor shall be in compliance of the following:
 - a. UL Standard for Safety 916
 - b. FCC Part 15.107 & 109, Class B, CFR47-15
 - c. EMC Directive 89/336/EEC (European CE Mark)
- H. Wall Sensor:
 1. Standard wall sensor shall use solid-state sensor identical to intelligent room sensor and shall be packaged in aesthetically pleasing enclosure. Sensor shall provide override function, warmer/cooler lever for set point adjustment and port for plug-in of Field Service Tool for field adjustments. Override time shall be stored in controller and be adjustable on a zone-by-zone basis. Adjustment range for warmer/cooler lever shall also be stored in EEPROM on controller. All programmable variables shall be available to Field Service Tool through wall sensor port.
- I. CO2 Sensors
 1. Provide indoor air quality sensors to monitor Carbon Dioxide (CO2) levels. Manufacturer shall be Vaisala Model GMW116 or Engineer approved equal.
 2. Sensors shall be of microprocessor-based photoacoustic type with heated stannic dioxide semiconductor, and have no more than 1% drift during the first year of operation.
 3. Wall mounted sensors shall be provided with white plastic cover without LED indicators.
 4. Duct mounted sensors shall be provided with LED indicators in a dust proof plastic housing with transparent cover.
 5. The sensor shall meet the following requirements:
 - a. Operating voltage: 24 VAC +/- 20%
 - b. Frequency: 50/60 Hz
 - c. Power Consumption: max 6 VA
 - d. CO2 measuring range: 0 – 2000 ppm
 - e. Tolerance: +/- 100 ppm
 - f. Output: 0 – 10 VAC
 - g. Calibration: none required
- J. Air Differential Pressure Transmitters

1. Air differential pressure sensors shall be Setra Model 267 with LCD display transmitters or Engineer approved equal.
2. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage and to hold calibrated accuracy when subject to a momentary 40% over-range input.
3. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device and shall be supplied with shutoff and bleed valves in the high and low sensing pick-up lines (3 valve manifolds).
4. Provide a minimum of a NEMA 1 housing for the transmitter. Locate transmitters in accessible local control panels wherever possible.
5. The pressure transmitter shall be capable of transmitting a linear electronic signal proportional to the differential of the room and reference static pressure input signals with the following minimum performance specifications.
 - a. Span: Refer to Points List
 - b. Accuracy: $\pm 0.5\%$ of full scale
 - c. Non-Repeatability: $\pm 0.05\%$
 - d. Non-Linearity: $\pm 0.35\%$
 - e. Response: Less than one second for full span input.
 - f. Temperature Stability: Less than $0.02\%FS/^{\circ}F$ change
 - g. Output: 4 to 20 mA

K. Water Differential Pressure Transmitters

1. Water differential pressure sensors shall be Rosemont Model 2051 with three valve manifold or Engineer approved equal.
2. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage and to hold calibrated accuracy when subject to a momentary 40% over-range input.
3. Provide the following:
 - a. NEMA 1 transmitter housing and locate in accessible local control panels wherever possible.
 - b. Brass 3-valve manifold assembly with shut-off and shunt valves.
 - c. Standard Viton/Silicone bleed screw seals.
 - d. Calibration certificate.
4. The pressure transmitter shall be capable of transmitting a linear electronic signal proportional to the differential of the pressure input signals with the following minimum performance specifications:
 - a. Span: Refer to points list.
 - b. Accuracy: $\pm 0.25\%$ of full scale.
 - c. Non-Repeatability: 0.05% .
 - d. Non-linearity: $\pm 0.20\%$
 - e. Response: 30 to 50 ms
 - f. Temperature Stability: Less than $0.20\% FS/^{\circ}F$.
 - g. Output: 4 to 20 mA.

L. Magnetic Flow Meters

1. Flow meter shall be Rosemont 8705 or Engineer approved equal with remote transmitter with display and keypad.
2. Provide remote transmitter with display and keypad.
3. Power 24VDC power supply as required.
4. BMS system shall monitor flow rates, pressure and temperature values.
5. Provide isolation valve kit to allow removal and servicing of meter while system is operating.
6. Provide flow meter that is pressure and temperature compensated and rated for chilled (40°F) and heating hot (200°F) service conditions.
7. Heating hot water flow meter shall be provided with ceramic lining.

M. Current Transformers

1. The current transformers shall be provided to be installed or removed without dismantling the primary bus or cables. The transformer shall be of a split core design.
2. The core and windings shall be completely encased in a UL approved thermoplastic rated 94VA. No metal parts shall be exposed other than the terminals.
3. The current transformers shall meet the following specifications.
 - a. Frequency Limits: 50 to 400 Hz.
 - b. Insulation: 0.6 KV Class, 10 KV BIL.
 - c. Accuracy: $\pm 1\%$ at 5.0 to 25.0 VA accuracy class with U.P.F. burden.
 - d. Provide a disconnect switch for each current transformer.

N. Current Switches

1. Current sensing switch shall be self-powered with solid-state circuitry and a dry contact output.
2. Current sensing switches shall consist of a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over current up to twice its trip into range.

O. Power Meters

1. Provide and install Accuenergy Acuvim IIW power quality meters where shown on electrical single line drawings indicating sub metering by Building Management System (BMS).
2. Multifunction power quality meter shall provide continuous monitoring of a three phase power system as required. Meter shall measure voltage, current, real and reactive power, real and reactive energy, current and power demand, power factor, frequency, etc. IO ports shall be provided for monitoring and controlling various functions for specific applications. Programmable alarm set-points shall be available for users to set over/under limit alarm parameters. Meter shall be accessible from BMS via Modbus or BACnet communication.
3. Safety Certificate & Testing
 - a. Meter shall be manufactured under an ISO9001 registered program.
 - b. Meter shall be UL and cUL listed, and CE marked.

- c. Meter shall conform to IEC 61010-1, UL61010-1 and cUL61010-1 safety standards.
 - d. Meter shall conform to emission compliance FCC Part 15 Subpart B, Class A, EN 55011, EN50081-2, IEC 61000-4/ -2-3-4-5-6-8-11 standards.
 - e. Meter shall conform to the IEC 60068-02 environment standard and conform to immunity standard EN 50082-2 for industrial environment.
 - f. Meter shall have an environmental tolerance rating of IP54 (NEMA 3)
 - g. Meter shall be able to store in -40°C to 85°C.
 - h. Meter (including LCD screen) shall be able to operate from -25°C to 75°C.
 - i. Meter shall have a dielectric strength of 2500 Vac for 1 minute to voltage input and shall withstand 1500 Vac continuously.
 - j. Meter shall accept input voltage range of 400 Vac L-N and 690 Vac L-L.
 - k. Meter shall have an isolation voltage rating of 2500 Vac for mechanical relay output and 2500 Vac for digital output.
 - l. Meter shall be able to withstand fault current at 100 Arms for 1 second and shall withstand 20 Arms continuously.
 - m. Meter shall accept universal power for control power supply input.
 - n. Meter shall provide optional low voltage DC power for control power supply input
4. Metering and Monitoring
- a. Data Logging
 - i. Meter shall have minimum 8MB of onboard memory to log interval data. The data interval shall be user-configurable from 1 minute to 1 day.
 - ii. Meter's onboard memory shall be user-configurable to log complete or partial meter's measurements.
 - iii. The datalogging configuration shall allow user to start logging immediately or log at specific start time and stop time.
 - b. Meter shall be panel mount design and shall be able to fit into a DIN 43700 (92mm x 92mm square hole) or ANSI C39.1 (4-inch round hole) cutting standard.
 - c. Meter front shall not exceed 96mm x 96mm in size when mounted on panel.
 - d. Meter shall have the option for standard 35mm DIN rail mount.
 - e. Meter shall include integrated display and control keys on the front panel of the meter for programming settings and viewing real-time measurements.
 - f. Integrated display shall be a Liquid Crystal Display (LCD) with backlight to clearly display measurement readings.
 - g. Meter shall provide indication signal such as flashing LCD backlight upon alarm conditions.
 - h. Meter shall be able to display all measured values on demand using the control keys on meters front panel.
 - i. Meter shall provide a true RMS measuring of V_{AN} , V_{BN} , V_{CN} , V_{AB} , V_{BC} , V_{CA} , I_A , I_B , I_C , I_N , voltage/current unbalance, power factor, line frequency, individual harmonics for voltage/current, THD, kW, kvars, kVA, import and export kWh/kvarh, kVAh, and demand readings for current and power. Maximum and minimum values of measured quantities shall also be recorded and date/time stamped.
 - j. Meter shall accept input current range of up to 10 Aac.
 - k. Meter shall support current input options of 333mV, RCT or mA for use with 333mV output CT's, Rogowski coil CT's and 80/100/200mA output CT's.

- l. Meter shall be able to provide demand metering for current and power. Demand shall be programmable either using Thermal or Sliding Window method with the demand interval from 1 to 30 minutes (increment of 1 min).
- m. Following measurement range, minimum resolution and full scale accuracy for the monitored parameters shall be provided:

Parameters		Accuracy	Resolution	Range
Voltage		0.2%	0.1V	10V~500kV
Current		0.2%	0.1mA	5mA~50000A
Power		0.2%	1W	-
Reactive Power		0.2%	1 Var	-
Apparent Power		0.2%	1 VA	0~9999MVA
Power Demand		0.2%	1W	-
Reactive Power Demand		0.2%	1 Var	-
Apparent Power Demand		0.2%	1 VA	0~9999MVA
Power Factor		0.2%	0.001	-1.000~1.000
Frequency		0.2%	0.01Hz	45.00~65.00Hz
Energy	Primary	0.2S	0.1kW	0-
	Secondary	0.2S	0.001	0-
Reactive Energy	Primary	0.2S	0.1	0-
	Secondary	0.2S	0.001	0-
Apparent Energy	Primary	0.2S	0.1	0-
	Secondary	0.2S	0.001	0-
Harmonics		2.0%	0.1%	0.0%~100.0%
Phase Angle		2.0%	0.1°	0.0°~359.9°
Unbalance Factor		2.0%	0.1%	0.0%~100.0%
Running Time			0.01h	0~99999999.99

5. Power Quality Analysis
 - a. Power analysis features shall include individual voltage/ current harmonic spectrum display (through the 63rd harmonic with odd, even and total harmonic distortion), THFF, voltage/ current unbalance factor, voltage crest factor and current K factor.
 - b. 512 waveform sample per cycle
 - c. Meter shall automatically generate log for max/min measurement parameter value. Events shall be recorded with time stamps and shall be stored in the meter.
6. Module Design
 - a. Meter shall have modules option for flexible and easy function expansion
 - i. Ethernet module shall be available for Ethernet communication.
 - ii. IO modules shall be available to support digital input, digital output, pulse output, relay output, analog input, and analog output functions.
 - iii. Wireless RS485 network 900Mhz module must be integral module to meter's base without requiring additional external power supply.
7. Alarming
 - a. User shall be able to set over/under limit alarm conditions for all measured quantities. These include frequency, phase voltage, line voltage, current,

- real/reactive/apparent power, voltage/current unbalance, power factor, power demand, etc...
 - b. Meter shall automatically generate log for over/ under limit alarm events. Events recorded with time stamp shall be stored in meter.
 - c. Alarming time delay tolerance shall be +/-20%.
8. Communication
- a. Meter shall support dual communication (serial communication through Modbus RTU and Ethernet or Wireless RS485 communication) and shall be able to communicate to master devices such as the Building Automation System using the two methods at the same time.
 - b. Modbus RTU: Meter shall be able to communicate using Modbus-RTU protocol over RS485 communication ports at baud rate up to 38400 bps. Through the use of communication, user shall be able to read/ write set-points, read actual values, execute commands and access the meter remotely.
 - i. Maximum of 32 meters shall be able to connect on the same RS485 serial communication network (daisy chain).
 - ii. Meter shall be able to connect to master controller via RF 900-950 Mhz radio frequency.
 - 1. Frequencies outside of this bandwidth is not acceptable and may interfere with other critical prison radio frequencies.
 - iii. RF communication shall be 128 bit AES encrypted
 - iv. RF communication shall support both point to multipoint and mesh communication topology
 - v. Each meter and its RF module shall be working as transmitter and repeater without additional hardware
 - vi. The wireless mesh network shall be self-healing and self-optimizing
 - vii. RF communication shall support automatic channel hopping
 - c. Modbus TCP:
 - i. Through the use of Ethernet module, meter shall be able to communicate over Local Area Network using TCP/IP. The module shall support both 10M and 100M connections.
 - ii. Ethernet module shall support both Modbus TCP and HTTP protocol.
 - iii. Meter with Ethernet module shall be capable to act as a HTTP server.
- P. Thermal Mass Natural Gas Flow Meters
- 1. The flow meter shall be Onicon F-5500 series inline/ insertion, or equal. Materials of construction for wetted metal components shall be 316ss. Each meter shall be individually wet-calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST. A certificate of calibration shall be provided with each flow meter. Insertion meters shall support hot tap installation without interrupting gas service. The insertion meter shall also be removable for service without disrupting flow.
 - 2. Accuracy
 - a. +/-1.0% of readings from 500-700 SFPM
 - b. +/-2.0% of readings from 100-500 SFPM
 - 3. Temperature accuracy +/-1.0 degree F over the range of -40 to 250 degrees F
 - 4. Flow Range: 15 to 35,000 SFPM
 - 5. Pipe Size Range:

- a. Insertion: 1.5" to 24" nominal diameter
 - b. Inline: 0.75" to 6" nominal diameter
6. Input Power: 12-28 VDC, 6W minimum power
7. Fluid Temperature Range: -40 to 250 degrees F
8. Ambient Temperature Range: -40 to 158 degrees F
9. Flow Sensor shall output:
 - a. 4-20 mA proportional signal
 - b. Or pulse, scaled pulse, or alarm (isolated open collector output)
10. Shall support a remote display.
11. Turbine sensors not allowed.

Q. Power Supplies and Line Filtering

1. Power Supplies. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
 - a. 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 150% current overload for at least three seconds without trip-out or failure.
 - b. Unit shall operate between 32°F and 120°F. EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
 - c. Line voltage units shall be UL recognized and CSA listed.
2. Power Line Filtering.
 - a. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
 - b. Dielectric strength of 1000 V minimum
 - c. Response time of 10 nanoseconds or less
 - d. Transverse mode noise attenuation of 65 dB or greater
 - e. Common mode noise attenuation of 150 dB or greater at 40-100 Hz

R. Field Service Tool:

1. Field service tool shall allow technician to view and modify all setpoints and tuning parameters stored in application controller. In addition, technician shall be able to view status of all inputs and outputs on digital readout. Each piece of data shall have a data code associated with it that is customizable.
2. Field service tool shall plug into wall sensor and provide all the functionality specified. Operator workstation shall include the capability to disable operation of the field service tool.

S. Network Connection Tool:

1. Network connection tool shall allow technician to connect a laptop to any MS/TP network or at any MS/TP device and view and modify all information throughout the entire BACnet network. Laptop connection to tool shall be via Ethernet or PTP.
2. Provide quick connect to MS/TP LAN at each controller. Tool shall be able to adjust to all MS/TP baud rates specified in the BACnet standard.

2.8 ELECTRONIC ACTUATORS AND VALVES

A. Quality Assurance for Actuators and Valves:

1. UL Listed Standard 873 and C.S.A. Class 4813 02 certified.
2. NEMA 2 rated enclosures for inside mounting, provide with weather shield for outside mounting.
3. Five-year manufacturers warranty. Two-year unconditional and three-year product defect from date of installation.

B. Execution Details for Actuators and Valves:

1. Furnish a Freeze-stat and install "Hard Wire" interlock to disconnect the mechanical spring return actuator power circuit for fail-safe operation. Use of the control signal to drive the actuators closed is not acceptable.
2. Terminal box damper actuation shall be Floating type or Analog (2-10vdc, 4-20ma).
3. Booster-heat valve actuation shall be Floating type or Analog (2-10vdc, 4-20ma).
4. Primary valve control shall be Analog (2-10vdc, 4-20ma).

C. Actuators for Damper and Control Valves ½" to 6" shall be Electric unless otherwise specified, provide actuators as follows:

1. UL Listed Standard 873 and Canadian Standards association Class 481302 shall certify Actuators.
2. NEMA 2 rated actuator enclosures are. Use additional weather shield to protect actuator when mounted outside.
3. 5 year Manufacturers Warranty. Two-year unconditional + Three year product defect from date of installation.
4. Mechanical spring shall be provided when specified. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
5. Position indicator device shall be installed and made visible to the exposed side of the Actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the Actuator.
6. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for Butterfly Valve actuators.
7. A push button gearbox release shall be provided for all non-spring actuators.
8. Modulating actuators shall be 24Vac and consume 10VA power or less.
9. Conduit connectors are required when specified and when code requires it.

D. Damper Actuators:

1. Outside Air and Exhaust Air Damper Actuators shall be Mechanical Spring Return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
 2. Economizer Actuators shall utilize Analog control 2-10 VDC, Floating control is not acceptable.
 3. Electric damper actuators (including terminal box actuators) shall be direct shaft mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or setscrew type fasteners are not acceptable.
 4. One electronic actuator shall be direct shaft mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
 5. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per damper section. (See below execution section for more installation details.)
- E. Valve Actuators ½" to 6":
1. Mechanical spring shall be provided on all actuators for pre-heat coil and actuators for AHU heating or cooling coil when units are mounted outside. See plans for fail save flow function: Normal Open or Normal Closed. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
 2. All zone service actuators shall be non-spring return unless otherwise specified.
 3. The valve actuator shall be capable of providing the minimum torque required for proper valve close off for the required application.
 4. All control valves actuators shall have an attached 3-foot cable for easy installation to a junction box.
 5. Override handle and gearbox release shall be provided for all non-spring return valve actuators.
- F. Control Valves: The BAS contractor shall furnish all specified motorized control valves and actuators. BAS contractor shall furnish all control wiring to actuators. The Plumbing contractor shall install all valves. Equal Percentage control characteristic shall be provided for all water coil control valves.
1. Manufacturer shall be Belimo or Engineer approved equal.
 2. Control Valves: Factory fabricated, of type, body material and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
 3. Pressure Independent Characterized Control Valves:
- G. NPS 2 and Smaller: Forged brass body rated at no less than 400 PSI, chrome plated brass ball and stem, female NPT union ends, dual EPDM librated O-rings and a brass or TEFZEL characterizing disc.
- H. NPS 2-1/2 through 6: GG25 cast iron body according to ANSI Class 125, standard class B, stainless steel ball and blowout proof stem, flange to match ANSI 125 with a dual EPDM O-ring packing design, PTFE seats, and a stainless steel flow characterizing disc.

- I. Accuracy: The control valves shall accurately control the flow from 0 to 100% rated flow with an operating pressure differential range of 5 to 50 psi differential across the valve with a valve body flow accuracy of ± 5 or $\pm 10\%$ total assembly error incorporating differential pressure fluctuation, manufacturing tolerances and valve hysteresis
- J. Flow Characteristics: equal percentage characteristic.
- K. All actuators shall be capable of being electronically programmed in the field by use of external computer software or a dedicated handheld tool for the adjustment of flow.
- L. The control valve shall require no maintenance and shall not include replaceable cartridges.
- M. The operating temperature range shall be 0° to 250° F.
 - 1. Globe valves ½" to 2" shall be used for steam control or water flow applications.
- N. Valves shall be bronze body, NPT screw type, and shall be rated for ANSI Class 250 working pressure.
- O. Valves 1/2 inch (DN15) through 2 inches (DN50) with spring return actuators shall close off against 50 psi pressure differential with Class III leakage (.1%).
- P. The operating temperature range shall be 20° to 280° F.
- Q. Spring loaded TFE packing shall protect against leakage at the stem.
- R. Two-way valves shall have an equal percentage control port.
- S. Three-way valves shall have a linear control and bypass port.
- T. Mixing and diverting valves must be installed specific to the valve design.
 - 1. Globe Valve 2 ½ to 6":
- U. Valves 2-1/2 inch (DN65) through 6 inches (DN50) shall be iron body, 125 lb. flanged with Class III (.1%) close-off leakage at 50 psi differential.
- V. Valves with spring return actuators shall close off against 50 psi pressure differential with Class III leakage (.1%).
- W. Flow type for two-way valves shall be equal percentage. Flow type for three-way valves shall be linear.
- X. Mixing and diverting valves must be installed specific to the valve design.
- Y. Butterfly Valves:
 - 1. Butterfly Valves shall be sized for modulating service at 60-70 degree stem rotation. Isolation valves shall be line-size. Design velocity shall be less than 12 feet per second when used with standard EPDM seats
 - a. Body is Cast Iron.

- b. Disc is Aluminum Bronze standard.
- c. Seat is EPDM Standard.
- d. Body Pressure is 200 psi, -30F to 275F.
- e. Flange is ANSI 125/250.
- f. Media Temperature Range is -22F to 240F
- g. Maximum Differential Pressure is 200 psi for 2" to 6" size.

Z. Butterfly Valve Industrial Actuators:

1. Actuators shall be approved under Canadian Standards Association or other Nationally Recognized Testing Laboratory to UL standards. CSA Class 4813 02 or equal. Enclosure shall be NEMA 4 (weatherproof) enclosure and will have an industrial quality coating.
 - a. Actuator shall have a motor rated for continuous duty. The motor shall be fractional horsepower; permanent split capacitor type designed to operate on a 120 VAC, 1 PH, 60 Hz supply. Two adjustable cam actuated end travel limit switches shall be provided to control direction of travel. A self-resetting thermal switch shall be imbedded in the motor for overload protection.
 - b. Reduction gearing shall be designed to withstand the actual motor stall torque. Gears shall be hardened alloy steel, permanently lubricated. A self-locking gear assembly or a brake shall be supplied.
 - c. Actuator shall have a 6 ft wiring harness provided for ease in field wiring (above 1500 in-lbs). Two adjustable SPDT cam-actuated auxiliary switches, rated at 250 VAC shall be provided for indication of open and closed position. Actuator shall have heater and thermostat to minimize condensation within the actuator housing.
 - d. Actuator shall be equipped with a hand wheel for manual override to permit operation of the valve in the event of electrical power failure or system malfunction. Hand wheel must be permanently attached to the actuator and when in manual operation electrical power to the actuator will be permanently interrupted. The hand wheel will not rotate while the actuator is electrically driven.
 - e. The actuator shall be Analog, floating, or two position as called out in the control sequence of operation. All Analog valves shall be positive positioning, and respond to a 2-10 VDC, 4-20 mA, or adjustable signal as required. Analog actuators shall have a digital control card allowing any voltage input for control and any DC voltage feedback signal for position indication.
2. Performance Verification Test:
 - a. Control loops shall cause productive actuation with each movement of the actuator and actuators shall modulate at a rate which is stable and responsive. Actuator movement shall not occur before the effects of previous movement have affected the sensor.
 - b. Actuator shall have capability of signaling a trouble alarm when the actuator Stop-Go Ratio exceeds 30%.

3. Actuator Mounting for Damper and Valve arrangements shall comply to the following:
 - a. Damper Actuators: Shall not be installed in the air stream.
 - b. A weather shield shall be used if actuators are located outside. For Damper Actuators use clear plastic enclosure.
 - c. Damper or valve actuator ambient temperature shall not exceed 122 degrees F through any combination of medium temperature or surrounding air. Appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation shall be provided as necessary
 - d. Actuator cords or conduit shall incorporate a drip leg if condensation is possible. Water shall not be allowed to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point shall be avoided to prevent water from condensing in conduit and running into actuator.
 - e. Damper mounting arrangements shall comply to the following:
 - 1) The ventilation subcontractor shall furnish and install damper channel supports and sheet metal collars.
 - 2) No jack shafting of damper sections shall be allowed.
 - 3) Multi-section dampers shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft mounted per section.
 - f. Size damper sections based on actuator manufacturers specific recommendations for face velocity, differential pressure and damper type. In general:
 - 1) Damper section shall not exceed 24 ft-sq. with face velocity £ 1500 FPM.
 - 2) Damper section shall not exceed 18 ft-sq. with face velocity £ 2500 FPM.
 - 3) Damper section shall not exceed 13 ft-sq. with face velocity £ 3000 FPM.
 - g. Multiple section dampers of two or more shall be arranged to allow actuators to be direct shaft mounted on the outside of the duct.
 - h. Multiple section dampers of three or more sections wide shall be arranged with a 3-sided vertical channel (8" wide by 6" deep) within the duct or fan housing and between adjacent damper sections. Vertical channel shall be anchored at the top and bottom to the fan housing or building structure for support. The sides of each damper frame shall be connected to the channels. Holes in the channel shall allow damper drive blade shafts to pass through channel for direct shaft mounting of actuators. Open side of channel shall be faced down stream of the airflow, except for exhaust air dampers.
 - i. Multiple section dampers to be mounted flush within a wall or housing opening shall receive either vertical channel supports as described above or sheet metal standout collars. Sheet metal collars (12" minimum) shall bring each damper section out of the wall to allow direct shaft mounting of the actuator on the side of the collar.
4. Valve Sizing for Water Coil
 - a. On/Off Control Valves shall be line size.

- b. Modulating Control Valve Body Size may be reduced at most two pipe sizes from the line size or not less than $\frac{1}{2}$ the pipe size. The BAS contractor shall size all water coil control valves for the application as follows:
 - 1) Booster-heat valves shall be sized not to exceed 4-9psi differential pressure. Size valve for 50% Valve Authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
 - 2) Primary valves shall be sized not to exceed 5-15psi differential pressure. Size valve for 50% Valve Authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
 - 3) Butterfly valves shall be sized for modulating service at 60-70 degree rotation. Design velocity shall be 12 feet per second or less when used with standard EPDM seats.
- c. Valve Mounting arrangements shall comply to the following:
 - 1) Unions shall be provided on all ports of two-way and three-way valves.
 - 2) Install three-way equal percentage Characterized Control valves in a mixing configuration with the "A" port piped to the coil.
 - 3) Install 2½ inch and above, Three-Way globe valves, as manufactured for mixing or diverting service to the coil.

2.9 NETWORK COMMUNICATION REQUIREMENTS

- A. Wired network communication shall follow the published guidelines for twisted pair BACnet network.
- B. Communication conduits shall not be installed closer than six feet from high power transformers or run parallel within six feet of electrical high power cables. Care shall be taken to route the cable as far from interference generating devices as possible. Where communication wire must cross high power wire (deemed as 110VAC or greater) it must do so at right angles.
- C. All shields shall be grounded (earth ground) at one point only to eliminate ground loops. All shield grounding shall be done at the controller location with the shield at the sensor/device end of the applicable wire being left long and "safed" off in an appropriate manner.
- D. There shall be no power wiring, in excess of 30 VAC rms, run in conduit with communications wiring. In cases where signal wiring is run in conduit with communication wiring, all communication wiring and signal wiring shall be run using separate twisted pairs (24awg) in accordance with the manufacturer's wiring practices

2.10 SPLICES

- A. Splices in shielded cables shall consist of terminations and the use of shielded cable couplers, which maintain the integrity of the shielding. Terminations shall be in accessible locations. Cables shall be harnessed with cable ties as specified herein

2.11 CONDUIT AND FITTINGS

- A. Conduit for Control Wiring, Control Cable and Transmission Cable: Electrical metallic tubing (EMT) with compression fittings, cold rolled steel, zinc coated or zinc-coated rigid steel with threaded connections.
- B. Outlet Boxes (Dry Location): Sheradized or galvanized drawn steel suited to each application, in general, four inches square or octagon with suitable raised cover.
- C. Outlet Boxes (Exposed to Weather): Threaded hub cast aluminum or iron boxes with gasket device plate.
- D. Pull and Junction Boxes: Size according to number, size, and position of entering raceway as required by National Electrical Codes. Enclosure type shall be suited to location.

2.12 RELAYS

- A. Relays other than those associated with digital outputs shall be general-purpose, enclosed plug-in type with 8-pin octal plug and protected by a heat and shock resistant duct cover. Number of contacts and operational function shall be as required.
- B. Relays associated with digital outputs shall have the ability to override the controlled equipment as a function of the relay. Relays shall be protected by a heat and shock resistant duct cover. Number of contacts and operational function shall be as required.

2.13 IDENTIFICATION

- A. Automatic Control Valve Tags
 - 1. For valves, etc., use metal tags with a 2-inch minimum diameter, fabricated of brass, stainless steel or aluminum. Attach tags with chain of same materials. For lubrication instructions, use linen or heavy duty shipping tag.
 - 2. Tag valves with identifying number and system. Number valves by floor level, column location and system served.
 - 3. Prepare lists of all tagged valves showing location, floor level, and tag number, use. Prepare separate lists for each system. Include copies in each maintenance manual.
- B. Wire Tags
 - 1. All multi-conductor cables in all pull boxes and terminal strip cabinets shall be tagged.
 - 2. Provide wire Tags as per Division 26.
- C. Conduit Tags
 - 1. Provide tagging or labeling of conduit so that it is always readily observable which conduit was installed or used in implementation of this Work.
- D. Miscellaneous Equipment Identification

1. Screwed-on, engraved black lamicaid sheet with white lettering on all control panels and remote processing panels. Lettering sizes subject to approval.
2. Inscription, subject to review and acceptance, indicating equipment, system numbers, functions and switches. For panel interior wiring, input/output modules, local control panel device identification.

2.14 ENCLOSURES

- A. All controllers, power supplies and relays shall be mounted in enclosures.
- B. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 4 when installed in other than a clean environment.
- C. Enclosures shall be NEMA 3R when installed outdoors or near potential water leakage.
- D. Enclosures shall have hinged, locking doors.
- E. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 1/8" thick sized appropriately to make label easy to read.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
- B. Notify the owners' representative in writing of conditions detrimental to the proper and timely completion of the work.
- C. Do not begin work until all unsatisfactory conditions are resolved.

3.2 INSTALLATION (GENERAL)

- A. Install in accordance with manufacturer's instructions.
- B. Provide all miscellaneous devices, hardware, software, interconnections installation and programming required to ensure a complete operating system in accordance with the sequences of operation and point schedules.

3.3 LOCATION AND INSTALLATION OF COMPONENTS

- A. Locate and install components for easy accessibility; in general, mount 48 inches above floor with minimum 3'-0" clear access space in front of units. Obtain approval on locations from owner's representative prior to installation.

- B. All instruments, switches, transmitters, etc., shall be suitably wired and mounted to protect them from vibration, moisture and high or low temperatures.
- C. Identify all equipment and panels. Provide permanently mounted tags for all panels.
- D. Provide stainless steel or brass thermowells suitable for respective application and for installation under other sections—sized to suit pipe diameter without restricting flow.

3.4 INTERLOCKING AND CONTROL WIRING

- A. Provide all interlock and control wiring. All wiring shall be installed neatly and professionally, in accordance with Specification Division 26.
- B. All wiring to be installed in conduit.
- C. Provide wiring as required by functions as specified and as recommended by equipment manufacturers, to serve specified control functions. Provide shielded low capacitance wire for all communications trunks.
- D. Control wiring shall not be installed in power circuit raceways. Magnetic starters and disconnect switches shall not be used as junction boxes. Provide auxiliary junction boxes as required. Coordinate location and arrangement of all control equipment with the owner's representative prior to rough-in.
- E. Provide auxiliary pilot duty relays on motor starters as required for control function.
- F. Provide power for all control components from nearest electrical control panel or as indicated on the electrical drawings—coordinate with electrical contractor.
- G. All control wiring in the mechanical, electrical, telephone and boiler rooms to be installed in raceways.
- H. Control power supply shall be from emergency power source for all equipment connected to emergency power.

3.5 120V POWER

- A. Provide 120V power to control panels from the nearest 208/120V receptacle or mechanical panel. Contractor shall provide minimum 3/4"C-2#10 and 1#10 GRD and connect to a spare circuit in the panel.
- B. Coordinate with the Electrical Contractor for spare circuit, and provide information to be included on the Electrical Contractor's As-Built red-line drawings.
- C. Electrical installation shall be done per Division 26 specifications.

3.6 DDC OBJECT TYPE SUMMARY

- A. Provide all database generation.
- B. Displays: System displays shall show all analog and binary object types within the system. They shall be logically laid out for easy use by the owner. Provide outside air temperature indication on all system displays associated with economizer cycles.
- C. Run Time Totalization: At a minimum, run time totalization shall be incorporated for each monitored supply fan, return fan, exhaust fan, hot water and chilled water pumps. Warning limits for each point shall be entered for alarm and or maintenance purposes.
- D. Trend log: All binary and analog object types (including zones) shall have the capability to be automatically trended.
- E. Alarm: All analog inputs (High/Low Limits) and selected binary input alarm points shall be prioritized and routed (locally or remotely) with alarm message per owner's requirements.
- F. Database Save: Provide back-up database for all stand-alone application controllers on disk.

3.7 FIELD SERVICES

- A. Prepare and start logic control system under provisions of this section.
- B. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- C. Provide Owner's Representative with spare parts list. Identify equipment critical to maintaining the integrity of the operating system.

3.8 AS BUILT DOCUMENTATION

- A. After completion of the project, insert final approved shop drawings include the following information:
 - 1. An operator's manual including detailed man-machine interface.
 - 2. An operator's reference table listing the addresses of all connected input points and output points. Show settings where applicable.
 - 3. A programmer's manual including all information necessary to perform the programming function.
 - 4. A language manual including a detailed description of the language used and all routines, modules, etc., used by the system.
 - 5. Flow charts of the software programs utilized in the system.
 - 6. Complete program listing file, and parameter listing file for all programs.
- B. Provide two (2) AutoCad (latest version) CD and one (1) full size reproducible of each control diagram and equipment schedule reflecting the "as-built" condition. Size shall be the same as the construction document drawings.

3.9 TRAINING

- A. Provide application engineer to instruct owner in operation of systems and equipment.
- B. Provide system operator's training to include (but not limited to) such items as the following: modification of data displays, alarm and status descriptors, requesting data, execution of commands and request of logs. Provide this training to a minimum of 3 persons.
- C. Provide on-site training above as required, up to 40 hours as part of this contract.

3.10 DEMONSTRATION

- A. Provide systems demonstration under provisions of Section 15010.
- B. Upon completion of the installation, start up the system and perform all necessary testing, debugging and calibration of each component in the entire system. Perform an acceptance test in the presence of the Owner's Representative. When the system performance is deemed satisfactory in whole or in part of the by the Owner's Representative, the part(s) of the system will be accepted.
- C. Provide certificate stating that control system has been tested and adjusted for proper operation.
- D. Final system acceptance shall be contingent upon completion of final review and correction of all deficiencies. Satisfactory completion of the operational tests which shall demonstrate compliance with all performance and requirements of the Contract Documents.

PART 4 - SEQUENCE OF OPERATIONS

4.1 GENERAL

- A. See specification section 15975

PART 5 - COMMISSIONING

5.1 COMMISSIONING REQUIREMENTS UNDER DDC CONTRACTOR

- A. Management:
 - 1. The Commissioning Agent (CA) is hired directly by the College.
 - 2. The CA directs and coordinates the commissioning activities and the reports to the College's Representative.
 - 3. All members work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.
 - 4. All contractors shall include the cost of commissioning in the contract price. The contractors should be prepared to provide commissioning assistance and follow through until all the commissioned systems have been signed off by the commissioning provider and the College Representative.
 - 5. In each purchase order or subcontract written, include requirements for submittal data,

commissioning documentation, O&M data and training

- B. Commissioning requires the participation of Division 15 Instrumentation and Controls contractor to ensure that all systems are operating in a manner consistent with the Design Intent.
 - 1. The general commissioning requirements and coordination are detailed in Division 1, Section 019000 General Commissioning Requirements and Division 15.
 - 2. Contractor shall be familiar with all parts of Division 1 and Division 15 and the commissioning plan issued by the Commissioning Authority and shall execute all commissioning responsibilities assigned to them in the Contract Documents.
- C. The Test and Balance contractor is responsible for assisting the commissioning agent throughout the entire commissioning process. The work is not complete until the commissioning agent and the College Representative has signed off on the commissioned systems.

5.2 COMMISSIONING RESPONSIBILITIES

- A. Controls Contractor: The commissioning responsibilities applicable to the controls contractor are as follows (all references apply to commissioned equipment only):
 - 1. All contractors shall include the cost of commissioning in the contract price. The contractors should be prepared to provide commissioning assistance and follow through until all the commissioned systems have been signed off by the commissioning provider and the College Representative.
 - 2. In each purchase order or subcontract written, include requirements for submittal data, commissioning documentation, O&M data and training.
 - 3. General Contractor shall attend a commissioning kickoff meeting and other meetings necessary to facilitate the commissioning process.
 - 4. General Contractor shall provide the Commissioning Provider with normal cut sheets and shop drawing submittals of commissioned equipment.
 - 5. General Contractor shall provide additional requested documentation, prior to normal O&M manual submittals, to the Commissioning Provider for development of start-up and functional testing procedures.
 - a. Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Provider.
 - b. The Commissioning Provider may request further documentation necessary for the commissioning process.
 - 6. General Contractor shall provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the Commissioning Provider for review.
 - 7. Sub-Contractors and design engineers shall assist in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

8. General Contractor shall provide limited assistance to the Commissioning Provider in preparing the specific functional performance test procedures. Sub-Contractors shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.
 9. General Contractor shall develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the pre-functional checklists from the Commissioning Provider for all commissioned equipment. Submit to Commissioning Provider for review prior to startup.
 10. During the startup and initial checkout process, execute the mechanical and electrical-related portions of the pre-functional checklists for all commissioned equipment.
 11. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the Commissioning Provider.
 12. Address current Engineer of Record punch list items before functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air- or water-related systems.
 13. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
 14. Provide skilled technicians to perform functional performance testing under the direction of the Commissioning Provider. Assist the Commissioning Provider in interpreting the monitoring data, as necessary.
 15. Correct deficiencies (differences between specified and observed performance) as interpreted by the Commissioning Provider, College's Representative and Engineer of Record and retest the equipment.
 16. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.
 17. During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update after completion of commissioning.
 18. Provide training of the College Representative's operating staff using expert qualified personnel, as specified.
 19. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
 20. Execute any deferred functional performance testing, witnessed by the Commissioning Provider, according to the specifications.
 21. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.
- B. Controls Contractor. The commissioning responsibilities of the controls contractor, during construction and acceptance phases in addition to those listed in (A) are:
1. Sequences of Operation Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:
 - a. An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components and function.

- b. All interactions and interlocks with other systems.
 - c. Detailed delineation of control between any packaged controls and the building automation system, listing what points the BAS monitors only and what BAS points are control points and are adjustable.
 - d. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included, but will generally require additional narrative).
 - e. Start-up sequences.
 - f. Warm-up mode sequences.
 - g. Normal operating mode sequences.
 - h. Unoccupied mode sequences.
 - i. Shutdown sequences.
 - j. Capacity control sequences and equipment staging.
 - k. Temperature and pressure control: setbacks, setups, resets, etc.
 - l. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
 - m. Effects of power or equipment failure with all standby component functions.
 - n. Sequences for all alarms and emergency shut downs.
 - o. Seasonal operational differences and recommendations.
 - p. Initial and recommended values for all adjustable settings, set-points and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
 - q. Schedules, if known.
 - r. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered.
2. Control Drawings Submittal.
- a. The control drawings shall have a key to all abbreviations.
 - b. The control drawings shall contain graphic schematic depictions of the systems and each component.
 - c. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
 - d. Provide a full points list with at least the following included for each point:
 - 1) Controlled system
 - 2) Point abbreviation
 - 3) Point description
 - 4) Display unit
 - 5) Control point or setpoint (Yes / No)
 - 6) Monitoring point (Yes / No)
 - 7) Intermediate point (Yes / No)
 - e. The Controls Contractor shall keep the Commissioning Provider informed of all changes to this list during programming and setup.

3. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.
4. Assist and cooperate with the Testing, Adjusting and Balancing (TAB) contractor in the following manner:
 - a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).
 - b. For a given area, have all required pre-functional checklists, calibrations, startup and selected functional tests of the system completed and approved by the Commissioning Provider prior to TAB.
 - c. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.
5. Assist and cooperate with the Commissioning Provider in the following manner:
 - a. Using a skilled technician who is familiar with this building, execute the functional testing of the controls system. Assist in the functional testing of all equipment to be commissioned. Provide two-way radios during the testing.
 - b. Execute all control system trend logs required in the construction documents and required by the commissioning provider.
6. The controls contractor shall prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional performance testing. At minimum, the plan shall include for each type of equipment controlled by the automatic controls:
 - a. System name.
 - 1) List of devices.
 - 2) Step-by-step procedures for testing each controller after installation, including:
 - 3) Process of verifying proper hardware and wiring installation.
 - 4) Process of downloading programs to local controllers and verifying that they are addressed correctly.
 - 5) Process of performing operational checks of each controlled component.
 - 6) Plan and process for calibrating valve and damper actuators and all sensors.
 - 7) A description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
 - 8) A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during calibration of each point and clearly indicate when a sensor or controller has "passed" and is operating within the contract parameters.
 - 9) A description of the instrumentation required for testing.

- 10) Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Provider and TAB contractor for this determination.
 - 11) Provide a signed and dated certification to the Commissioning Provider and College's Representative upon completion of the checkout of each controlled device, equipment and system prior to functional testing for each piece of equipment or system, that all system programming is complete as to all respects of the Design Intent and Contract Documents, except functional testing requirements.
 - 12) As well as the control points necessary to execute all documented control sequences, provide monitoring, control and virtual points for all commissioned equipment communicating with the EMS, including mechanical, electrical, and plumbing equipment.
- C. List and clearly identify on the as-built duct and piping drawings the locations of all static and differential pressure sensors (air, water and building pressure).

END OF SECTION 15975

SECTION 233113

METAL DUCTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section includes rectangular, round metal ducts, plenums and casings for heating, ventilating, and air-conditioning systems in pressure classes from minus 2- to plus 10-inch wg.
- B. This section includes low pressure ductwork and fittings. All supply, return and exhaust ductwork shall be galvanized steel.
- C. Duct system design, as indicated, has been used to select and size air-moving and distribution equipment and other components of air system. Changes to layout or configuration of duct system must be specifically approved in writing by the University's Representative. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.2 QUALITY ASSURANCE

- A. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

ASTM A36	Structural Steel.
ASTM A90	Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
ASTM A167	Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
ASTM A525	General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
ASTM A527	Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
NFPA 90A	Installation of Air Conditioning and Ventilating Systems.
NFPA 90B	Installation of Warm Air Heating and Air Conditioning Systems.
NFPA 91	Installation of Blower and Exhaust Systems for Dust, Stock and Vapor Removal or Conveying.
SMACNA ADLTM	HVAC Air Duct Leakage Test Manual.
SMACNA DCS	HVAC Duct Construction Standards - Metal and Flexible.
UMC	Uniform Mechanical Code

- B. No variation of duct configuration or sizes permitted except by written permission. Upon written permission size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.
- C. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- D. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

- E. Installer: Company specializing in performing the work of this section with minimum five years documented experience.
- F. Construct ductwork to NFPA 90A&B standards. Duct gauges shall conform to CAC Title 24 UMC unless otherwise specified in this section.
- G. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

1.3 SUBMITTALS

- A. Submit the following under provisions of Section 23 05 00:
- B. Shop Drawings: Provide 1/4" = 1' duct layout drawings indicating duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work as required by Section 23 05 19.
 - 1. Product Data: Provide data for duct materials and joints.
 - 2. Show details of Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work. Duct layout indicating pressure classifications and sizes on plans. Fittings. Reinforcement and spacing. Seam and joint construction. Penetrations through fire-rated and other partitions. Terminal unit, coil installations. Hangers and supports, including methods for building attachment, vibration isolation, seismic restraints, and duct attachment.
 - 3. Coordination Drawings: Ductwork plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show other systems installed in same space as ducts. Access doors and panels required to provide access to dampers duct cleanout. Coordination with ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.
 - 4. Welding Certificates: Copies of certificates indicating welding procedures and personnel comply with requirements in "Quality Assurance" Article.
 - 5. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.4 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 23 05 00.
- B. Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Galvanized Steel Ducts: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Stainless Steel Ducts: ASTM A167 Type 316 L stainless steel as specified in this Section. Provide ASTM A480 No. 4 finish for ducts exposed to view and No. 2 finish for concealed ducts. Only Type 316 L, stainless steel ductwork on this project is the lab exhaust system from the labs to the fan intake plenum of the exhaust fans.
- C. Fasteners: Rivets, bolts, or sheet metal screws shall be cadmium plated.

- D. Sealant: Non-hardening, water-resistant, fire resistive, compatible with mating materials; liquid used alone or with heavy mastic. Sealant shall meet the requirements of the South Coast Air Quality Management District (SCAQMD) Rule #1168.
- E. Hanger Rod: ASTM A36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 SEALANT MATERIALS

- A. Joint and Seam Sealants, General:
- B. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 75 percent solids.
 - 1. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

2.3 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for building materials.
- B. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 1. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Materials: Galvanized, sheet steel or round, threaded steel rod.
- D. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rod.
 - 1. Straps and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for sheet steel width and thickness and for steel rod diameters.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
- G. Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.
 - 1. Supports for Stainless-Steel Ducts: Stainless-steel support materials, unless materials are electrolytically separated from ductwork.

2.4 DUCTWORK FABRICATION

- A. All ductwork shall be constructed to meet SMACNA requirements in Section 7 of the SMACNA "HVAC Duct Construction Standards - Metal and Flexible" 1985. Unless otherwise indicated, provide duct material, gages, reinforcing, and sealing for operating pressures indicated. Circular ducts shall be spirally seamed.
- B. Transverse Joints: Ductmate, WDCI or equal duct connection systems will be accepted. Ductwork constructed using these systems will refer to the manufacturers guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.

TDC/TDF/T-24 shall be constructed as a SMACNA T-24 flange. Use of these joint systems shall be limited as follows:

Duct Size	Operating Pressure
0 - 42"	0 - 6" W.G.

- C. Longitudinal Seams: Pittsburgh Lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.
- D. Ductboard: Fiberglass ductboard will not be accepted.
- E. The Contractor will be required to replace proprietary duct construction and transverse joining systems that are installed without authorization.
- F. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide extended trailing edge turning vanes.
- G. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- H. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard.
 - 1. Joints: 0" - 20" diameter, interior slip coupling beaded at center, fastened to duct with screws and with sealing compound applied continuously around joint before assembling and after fastening. Wrap joints with 3 inch wide duct tape.
- I. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

2.5 MANUFACTURED DUCTWORK AND FITTINGS

- A. Manufacture in accordance with SMACNA DCS, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

2.6 CASINGS

- A. Fabricate casings in accordance with SNACNA and construct for operating pressures indicated.
- B. Mount floor mounted casings directly to concrete floor with application of duct sealer and low velocity shots and pins. At floor and ceiling fasten panels on 12 inch centers to fabricated channels.
- C. Fabricate door frames from sheet metal Z Section. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
- D. Fabricate acoustic casings with reinforcing turned inward. Provide 18 gage back facing and 22 gage perforated front facing. Construct panels 3 inches thick packed with 0.75/cu ft minimum glass fiber media.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install manufactured ductwork and fittings in accordance with manufacturer's instructions.
- B. Install and seal ducts in accordance with SMACNA DCS and SMACNA HVAC Air Duct Leakage Test Manual.
- C. Contractor shall verify all dimensions at the site, making all field measurements and shop drawings necessary for fabrication and erection of sheet metal work. Make allowances for beams, pipes and other obstructions in building construction and for Work of other Sections. Check Drawings showing Work of other trades and consult with the University in the event of potential interference.
- D. Duct sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- E. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- G. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.
- H. Use double nuts and lock washers on threaded rod supports.
- I. Fabricate ductwork in a workmanlike manner with airtight joints, presenting smooth surfaces on inside, neatly finished on outside, construct with curves, bends, turning vanes to aid the easy flow of air.
- J. Connect diffusers to low pressure ducts directly.
- K. Provide seismic transverse and longitudinal bracing for ductwork per Section 23 05 48.
- L. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- M. All exposed ductwork and supports shall be primed and painted. All ductwork shall be considered exposed unless concealed in shafts or ceiling spaces. Color to be selected by the University.
- N. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.

3.2 SCHEDULES

- A. DUCTWORK MATERIAL SCHEDULE

<u>AIR SYSTEM</u>	<u>MATERIAL</u>
Toilet Exhaust Systems	Galvanized Steel
General Exhaust Systems	Galvanized Steel
Supply and Return Air	Galvanized Steel

B. MINIMUM DUCTWORK PRESSURE AND SEAL CLASSES

<u>SYSTEM</u>	<u>SMACNA PRESSURE CLASS</u>	<u>SMACNA SEAL CLASS</u>	<u>RECT / ROUND LEAKAGE CLASS</u>
Exhaust	3 inch W.G.	B	12 / 6
Supply	2 inch W.G.	C	24/12
Return	2 inch W.G..	C	24/12

Seal Class A: Sealing applicable, joints, seams, and all wall penetrations

Seal Class B: Sealing Applicable, traverse joints and seams

Seal Class C: Sealing applicable, traverse joints only.

END OF SECTION

SECTION 233300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies ductwork accessories such as volume control dampers, backdraft dampers, air turning vanes, flexible duct connections, duct access doors, duct test holes, combination fire smoke dampers and intake vents.

1.2 QUALITY ASSURANCE

- A. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

NFPA 90A	Installation of Air Conditioning and Ventilating Systems.
SMACNA	Low Pressure Duct Construction Standards.
UL 33	Heat Responsive Links for Fire-Protection Service.
UL 555	Fire Dampers and Ceiling Dampers.

1.3 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Division 01 Section on submittals.
- B. For each product submitted, indicate paragraph(s) of compliance in specifications.
- C. Where multiple options exist for a product, indicate which options have been provided.
- D. Provide shop drawings for shop fabricated assemblies indicated, including volume control dampers and duct access doors. Provide product data for hardware used.

PART 2 - PRODUCTS

2.1 VOLUME CONTROL DAMPERS

- A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.
- B. Fabricate splitter dampers of material same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
- C. Fabricate splitter dampers of single thickness sheet metal to streamline shape. Secure blade with continuous hinge or rod. Operate with minimum 1/4 inch diameter rod in self aligning, universal joint action flanged bushing with set screw.
- D. Fabricate single blade dampers for duct sizes to 12 x 48 inch.

- E. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- F. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
- G. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends.
- H. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

2.2 BACKDRAFT DAMPERS

- A. Manufactures shall be Ruskin, Greenheck or equal.
- B. Gravity backdraft dampers, size 18 x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturers standard construction.
- C. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of extruded aluminum, with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure; Model BD6 manufactured by Ruskin.

2.3 AIR TURNING VANES

- A. Multi-blade device with blades aligned in short dimension; blades shall have long trailing edges; steel or aluminum construction; with individually adjustable blades, mounting straps. Manufacturer shall be Aero/Dyne or equal (no known equal).

2.4 FLEXIBLE DUCT CONNECTIONS

- A. Manufacturer: Ventfabrics or equal (no known equal).
- B. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.
- C. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd, approximately 6 inches wide, crimped into metal edging strip.
- D. Leaded vinyl sheet, minimum 0.55 inch thick, 0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

2.5 DUCT ACCESS DOORS

- A. Manufacturers shall be Ventfabrics, Ductmate, Pottorf Company or equal.
- A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards and as indicated.

- B. Review locations prior to fabrication.
- C. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.
- D. Access doors smaller than 12 inches square may be secured with sash locks.
- E. Provide two hinges and two sash locks for sizes up to 18 inches square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 inches. Provide an additional hinge for larger sizes.
- F. Access doors in round ducts shall be Ductmate, United Sheet Metal Type AR-W Peabody, Wind Spiromatic, Spiro-Duct or equal.
- G. Access doors with sheet metal screw fasteners are not acceptable.

2.6 DUCT TEST HOLES

- A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent test holes shall be factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions.
- B. Provide balancing dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Use splitter dampers only where indicated.
- C. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment such as air handling units and exhaust fans.
- D. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at combination fire/smoke dampers as required for access. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated.
- E. Provide duct test holes where indicated and required for testing and balancing purposes.

END OF SECTION

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SECTION 233423 – HVAC FANS

PART 1 - GENERAL

1.1 SCOPE

- A. This section specifies exhaust fans.

1.2 QUALITY ASSURANCE

- A. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

AMCA 99	Standards Handbook.
AMCA 210	Laboratory Methods of Testing Fans for Rating Purposes.
AMCA 300	Test Code for Sound Rating Air Moving Devices.
AMCA 301	Method of Publishing Sound Ratings for Air Moving Devices.
NFPA 70	National Electrical Code.
UL 705	Power Ventilators.

1.3 SUBMITTALS

- A. Refer to Section 15010 for additional requirements.
- B. Submit:
 - 1. Provide data on fans and accessories including fan curves with specified operating point clearly plotted, sound power levels at rated capacity, and electrical characteristics and connection requirements.
 - 2. Submit motor data per section 15170. Submit data indicating motor with shaft grounding.
 - 3. Submit roof curb data. Provide shop drawings detailing the mounting and securing of fan to roof curb.
 - 4. Fan manufacturer shall furnish a certificate of guarantee stating that the fan, mixing plenum, outlet nozzle, acoustical silencer nozzle, stack extension if any, and all related accessories specified herein have been pre-tested at the factory and that the curves supplied in 1.2.1 have been de-rated for any and all system effects created by the accessories.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 15010.

- B. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 EXTRA MATERIALS

- A. Provide one extra set of belts for each fan.

PART 2 - PRODUCTS

2.1 ALUMINUM ROOF FAN

- A. Manufacturer shall be Greenheck, Loren Cook, or Twin City Fan.
- B. Product Requirements:
 - 1. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
 - 2. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
 - 3. Fabrication: Conform to AMCA 99.
 - 4. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
- C. Performance: As scheduled on Drawings.
- D. Description:
 - 1. Fan shall be a spun aluminum, roof mounted, belt driven, upblast, standard finish centrifugal exhaust ventilator.
 - 2. Selected fans shall be capable of accommodating static pressure and flow variations of minimum +/-20% of scheduled values.
- E. Construction:
 - 1. Fan shall be of bolted and welded construction utilizing corrosion resistant fasteners.
 - 2. Spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure.
 - 3. Aluminum base shall have a one piece inlet spinning and continuously welded curb cap corners for maximum leak protection. Windband shall have a rolled bead for added strength and shall be joined to curbcaps with a leakproof, continuously welded seam.
 - 4. Provide integral conduit chase shall be provided into the motor compartment to facilitate wiring connections.
 - 5. Motor, bearings and drives shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators.
 - 6. All components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream.
 - 7. Lifting lugs shall be provided to help prevent damage from improper lifting.

8. Unit shall bear weatherproof, engraved aluminum nameplate. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM.

F. Wheel:

1. Wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances.
2. Wheels shall be statically and dynamically balanced.
3. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

G. Motor:

1. Motors shall be high efficiency, heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage and phase.
2. Motors and drives shall be mounted on vibration isolators, out of the airstream.
3. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants.
4. Motors shall be readily accessible for maintenance.
5. Motor enclosure shall be Totally Enclosed Fan Cooled (TEFC).

H. Bearings:

1. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings.
2. Construction shall be heavy duty regreasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

I. Belts and Drives:

1. Belts shall be oil and heat resistant, non-static type.
2. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts.
3. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.
4. Drives shall be sized for 150 percent of the installed motor horsepower.
5. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
6. Motor pulleys shall be adjustable for final system balancing.

J. Accessories:

1. Gravity operated, heavy duty, aluminum back draft damper.
 - a. Back draft damper is not required for relief fan (RF-101).
2. Aluminum bird screen.
3. Provide with 1'-0" high aluminum curb with internal liner.
4. Lifting lugs.

5. Performance baffle as required to meet design conditions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide sheaves required for final air balance.
- C. Install gravity actuated dampers on inlet to roof exhausters.
- D. Do not operate fans for any purpose, bearings are lubricated, and fan has been test run under observation.

END OF SECTION 15870

SECTION 233713

DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies ceiling diffusers, linear diffusers, return grilles, linear grilles and exhaust grilles.

1.2 QUALITY ASSURANCE

- A. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

ADC 1062	Certification, Rating and Test Manual.
NFPA 90A	Installation of Air Conditioning and Ventilating Systems.
ASHRAE 70	Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.

- B. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

- C. Conform to NFPA 90A.

1.3 SUBMITTALS

- A. Submit the following under provisions of Section 23 05 00.
 - 1. Provide product data for items required for this project.
 - 2. Submit schedule of outlets and inlets indicating type, size, location, application, and noise level.
 - 3. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.
 - 4. For each item submitted, indicate paragraph(s) of compliance in specifications.
 - 5. Where multiple options/features exist for a product, indicate which options have been selected for the submitted product.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CEILING DIFFUSERS (SQUARE PLAQUE)

- A. Manufacturers shall be Titus, Omni, Carnes, Krueger, Nailor, Anemostat or equal.
- B. The diffuser shall have an 22-gauge steel face panel that captures a secondary 22-gauge panel and shall have a heavy gauge aluminum face panel that captures a secondary heavy gauge aluminum panel. The diffuser is entirely aluminum and will perform in MRI applications. The face panel is removable by means of four hanger brackets. The exposed surface of the face panel shall be smooth, flat, and free of visible fasteners.

- C. The face panel shall project $\frac{1}{4}$ inch below the outside border of the diffuser backpan. Panels projecting more than $\frac{1}{4}$ inch below the outside border are not acceptable. The back of the face panel shall have an aerodynamically shaped, rolled edge to ensure a tight horizontal discharge pattern. A single metal thickness on the edges of the face panel will not be accepted. Ceiling diffusers with a 24 x 24-inch full face shall have no less than an 18 x 18-inch face panel size. Ceiling diffusers with a 12 x 12-inch full face shall have no less than a 9 x 9-inch face panel size.
- D. The backpan shall be one piece precision die-stamped and shall include an integrally drawn inlet (welded-in inlets and corner joints are not acceptable). The diffuser backpan shall be constructed of 22-gauge steel or aluminum. The diffuser neck shall have a minimum of 1- $\frac{1}{4}$ inch in depth available for duct connection.
- E. The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes.

2.2 PERFORATED CEILING DIFFUSERS

- A. Manufacturers shall be Titus PCS, Carnes, Krueger, Nailor, Anemostat or equal.
- B. The Diffusers shall have a perforated face with 3/16-inch diameter holes on $\frac{1}{4}$ -inch staggered centers and no less than 51 percent free area. Perforated face shall be steel. The backpan shall be one piece stamped heavy gauge steel of the sizes and mounting types shown on the plans and outlet schedule. The diffuser neck shall have 1 $\frac{1}{8}$ -inch depth for easy duct connection.
- C. Diffusers must discharge a uniform horizontal blanket of air into the room and protect ceiling against smudging. Pattern controllers in the supply models shall be mounted on the back of the perforated face and must be field adjustable to allow the discharged air to enter the room in either vertical or one-, two-, three- or four-way horizontal jets. The perforated face must be easily unlatchable from the backpan to facilitate option of the face for pattern controller adjustment or to access an optional damper.
- D. The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
- E. film.

2.3 PERFORATED RETURN GRILLE

- A. Manufacturers shall be Titus PAR, Carnes, Krueger, Nailor, Anemostat or equal.
- B. Return grille shall be perforated face type ceiling diffuser. Grille shall have a perforated face with 3/16-inch diameter holes on $\frac{1}{4}$ -inch staggered centers and no less than 51 percent free area.
- C. Grille finish shall be white, anodic acrylic paint baked and must conform to ASTM B117, ASTM D870 and ASTM D-2794 requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install items in accordance with manufacturers' instructions.
- B. Provide balancing dampers on duct take-off to grilles and diffusers.
- C. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION

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SECTION 23 81 26

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 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION 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.

1.01 Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

- 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- 2. Wiring Diagrams: For power, signal, and control wiring.

1.02 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

1.03 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.04 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 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."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.06 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 Section 033000 "Concrete."

1.07 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: Five 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.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
 - 2. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.

3. Or approved equal.

2.02 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. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
4. Fan: Direct drive, centrifugal.
5. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "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 electrical Sections.
 - f. Mount unit-mounted disconnect switches on [exterior] [interior] of unit.
 - g. <Insert unique motor characteristics>.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Condensate Drain Pans:
 - a. Fabricated with two 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 to comply with ASHRAE 62.1.
 - 2) Depth: A minimum of 1 inch deep.
 - b. Single-wall, galvanized -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
8. Air Filtration Section:
 - a. General Requirements for Air Filtration Section:
 - 1) Comply with NFPA 90A.
 - 2) Washable permanent filter

2.03 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. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F.
7. Mounting Base: Polyethylene.

2.04 ACCESSORIES

- A. Control equipment are specified in Section 230900 "Building Automation Control System"
- B. Thermostat: Low voltage with to control compressor and evaporator fan, with the following features:
 1. 24-hour time control of system stop and start.
 2. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
 3. Fan-speed selection including auto setting.
- C. Automatic-reset timer to prevent rapid cycling of compressor.
- D. 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.
- E. Drain Hose: For condensate.

2.05 CAPACITIES AND CHARACTERISTICS

- A. Meet requirements on mechanical plans.

PART 3 - EXECUTION

3.01 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 ground-mounted, compressor-condenser components on 6-inch-thick, reinforced concrete base that is 6-inches larger, on each side, than unit. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.
- D. Install seismic restraints.
- E. Install and connect refrigerant tubing to component's fittings. Install tubing to allow access to unit.

3.02 CONNECTIONS

- A. Piping installation requirements are specified in other 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.

3.03 FIELD QUALITY CONTROL

- A. 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.
- B. Remove and replace malfunctioning units and retest as specified above.
- C. Prepare test and inspection reports.

END OF SECTION

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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

- A. ASTM: American Society of Testing Materials.
- B. ICEA: Insulated Cable Engineers Association.
- C. IEEE: Institute of Electrical & Electronics Engineers.
- D. NEMA: National Electrical Manufacturers Association.
- E. NETA ATS: InterNational Electrical Testing Association - Acceptance Testing Specification.
- F. VFC: Variable frequency controller.

1.4 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for each type of product, indicating conductor/cable construction, insulation material, thickness of insulation, jacket, cable stranding, and voltage rating of each type of conductor/cable specified, splices and terminations. Indicate date and place of manufacture for each conductor/cable, cable, splice and termination.
- B. Manufacturer's ISO certification.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Independent testing agency.

- B. Field quality-control reports. Perform field testing of cables per para 3.8. Submit six (6) copies of field test reports to owner's representative within two (2) weeks of completion of test.

1.6 QUALITY ASSURANCE

- A. Product Data: Submit manufacturer's technical data for each type of product, indicating conductor/cable construction, insulation material, thickness of insulation, jacket, cable stranding, and voltage rating of each type of conductor/cable specified, splices and terminations. Indicate date and place of manufacture for each conductor/cable, cable, splice and termination.
- B. Manufacturer's ISO certification.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Independent Testing Agency.
- B. Field quality-control reports. Perform field testing of cables per para 3.8. Submit six (6) copies of field test reports to owner's representative within two (2) weeks of completion of test.

1.8 QUALITY ASSURANCE

- A. General Requirements: The low voltage power conductors and cable shall be copper, minimum 600V rated unless otherwise indicated. Aluminum conductors and cables shall not be accepted unless otherwise indicated.
- B. Materials and installation shall meet or exceed requirements in the following referenced standards and shall be listed and labelled by UL.
 - 1. ICEA S-93-639/ NEMA WC 74.
 - 2. AEIC CS8.
 - 3. UL 1072.
 - 4. IEEE.
 - 5. ASTM.
 - 6. NEMA.
- C. Conductors and cables shall be of the same manufacturer, and shipped to the job site in original unbroken reels.
- D. Conductors and cables shall be manufactured with in twelve (12) months of installation. Date of manufacture shall be clearly marked on conductors or conductor reels.
- E. Manufacturer shall have minimum ten (10) years' experience in the manufacturer of conductors and cables similar to those specified on this project.
- F. Manufacturer shall have ISO 9001 and ISO 9002 certification.
- G. All conductors and cables shall be new and supplied by a local distributor.

- H. American made conductors and cables have been acceptable. If non-domestic product is submitted, notice is hereby given that extensive testing shall be required to insure quality and conformance to the Specifications. All of the testing procedures and results shall be satisfactory to the Owner's representative. The Contractor shall bear all costs for testing and shall be responsible for all costs associated with travel, lodging, etc. for the Owner's Representative to witness the test at the manufacturer's testing facility. The Contractor shall reimburse the Owner at \$1,200 per man day or part thereof for the time required to witness the testing.
- I. Testing: Provide the services of an independent qualified testing laboratory to perform the specified field tests. Notify the University's Representative fourteen (14) days in advance of performance of work requiring testing.
- J. Conductors, cables, splices and terminations shall be manufactured within twelve (12) months of installation. Each item shall have a permanent marking on the product or the original manufacturers' package indicating the date of manufacture unless otherwise noted.
- K. Testing Agency Qualifications: Member Company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. General Cable; General Cable Corporation.
 - 2. Okonite Company (The)
 - 3. Southwire Company.
- B. Conductor Material: Electrical grade, soft drawn annealed copper, 98 percent conductivity, and fabricated in accordance with ASTM and ICEA standards. Minimum size is number 12 for branch circuits, number 14 stranded for control wiring. Aluminum conductors are not permitted.
- C. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- D. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2 and Type XHHW-2.
- E. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. 3M.

2. Ideal Industries, Inc.
3. Tyco Electronics Corp.

- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- C. Copper conductors shall be terminated in copper or bronze mechanical connectors or lugs or tool applied compression connections made of copper for all connections except those on wiring devices.
- D. Pressure type connectors are not permitted.

2.3 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger, except VFC cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.
- G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- H. Feeders in Cable Tray: Type THHN-2-THWN-2, single conductors in cable tray.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Grounding systems and equipment.
- B. Section includes grounding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Ground and bonding.
 - 3. Foundation steel electrodes.

1.3 DEFINITIONS

- A. NETA ATS: InterNational Electrical Testing Association - Acceptance Testing Specification.
- B. NETA MTS: InterNational Electrical Testing Association - Maintenance Testing Specification.
- C. NFPA: National Fire Protection Association.
- D. NGR: Neutral Grounding Resistor.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical catalog cuts for each type of product indicated.
- B. Shop Drawings: Site drawings to scale including details showing location and size of each field connection of grounding system.
 - 1. Wiring Diagrams: Differentiate between manufacturer installed and field installed wiring.
- C. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding conductors, connectors
 - 5. Grounding arrangements and connections for separately derived systems.

6. Grounding for sensitive electronic equipment.

- D. Qualification Data: For qualified independent testing agency and testing agency's field supervisor.
- E. Field quality-control reports: Submit written test reports including the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Instructions for periodic testing and inspection of grounding features at test wells and ground rings based on NETA MTS and NFPA 70B.
 - a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - b. Include recommended testing intervals.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 - 1. Testing agency shall be an independent company; shall have been a member of NETA for a minimum of last ten (10) years and has permanent in-house testing engineers and technicians involved with testing of grounding systems similar to those specified on this project.
 - 2. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
 - 3. Field Testing technician and supervisor shall have minimum ten (10) years' experience in field testing of rounding systems of the type and rating similar to the systems to be tested on this project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 GROUNDING ELECTRODES, CONDUCTORS, CONNECTOR, BUS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equal:
 - 1. Grounding Connectors, Bars and Rods:
 - a. Erico Inc.; Electrical Product Group
 - b. Burndy Electrical.
 - c. Ideal Industries, Inc.
 - d. O-Z/Gedney Co.; a business of the EGS Electrical Group.
 - e. Thomas & Betts, Electrical.
 - f. Or Equal.
 - 2. Grounding Conductors and cables:
 - a. Southwire
 - b. American Insulated Wire
 - c. Okonite
 - d. Or Equal.

2.2 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.3 CONNECTORS

- A. Listed and labeled by an UL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- E. Conduit Hubs: Mechanical type, terminal with threaded hub.
- F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- G. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- H. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- I. Straps: Solid copper, copper lugs. Rated for 600A unless otherwise noted.
- J. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, 3/4 inch by 10 feet in diameter.
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
 - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
 - 2. Backfill Material: Electrode manufacturers recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare Copper conductor, No. 4/0 AWG minimum.
 - 1. Bury at least 24 inches below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Factory installed Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to

normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits in the same conduit containing phase and neutral conductors. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70. :
1. Feeders and branch circuits.
 2. Lighting circuits.
 3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
 7. Armored and metal-clad cable runs.
 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- C. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from

panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

- D. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
1. Interconnect ground rods with grounding electrode conductor below grade using exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
- C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems".
1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
 2. Test Wells near light poles: Coordinate location with drawings and install one at each pole. Test well shall be open bottom and installed on a 12"H bed of gravel or crushed stone (1" size).
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
1. Install tinned-copper conductor not less than No. 4/0 AWG for ground ring and for taps to building steel.
 2. Bury ground ring not less than 24 inches from building's foundation.
- F. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No 4/0 AWG.

1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.6 LABELING

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
 1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage an independent qualified testing agency to perform tests and inspections. All costs associated with testing shall be included in the bid.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at ground test wells and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

- F. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 - 4. Substation and Pad-Mounted Equipments: 5 ohms
 - 5. Manhole Grounds: 10 ohms.
- G. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify University's Representative promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
 - 1. Section 260548 "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Adjust list below to suit Project.
 - 2. Trapeze hangers. Include Product Data for components.
 - 3. Steel slotted channel systems. Include Product Data for components.
 - 4. Nonmetallic slotted channel systems. Include Product Data for components.
 - 5. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Seismic Qualification Certificates: For hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.7 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. Thomas & Betts Corporation, A Member of the ABB Group.
 - c. Unistrut; an Atkore International company.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Hilti, Inc.
 - 3) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 5. Toggle Bolts: All-steel springhead type.
 - 6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 3. To Existing Concrete: Expansion anchor fasteners.
 - 4. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.

- 5. To Light Steel: Sheet metal screws.
 - 6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete.
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Comply with requirements in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

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SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Nonmetal conduits, tubing, and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Surface raceways.
 - 5. Boxes, enclosures, and cabinets.
- B. Related Requirements:
 - 1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.

1.4 QUALITY ASSURANCE:

- A. Each conduit, raceway, boxes, cabinet power-pole etc. shall be UL listed, bear manufacturer's trademark and UL label.
- B. Each type of conduit and fittings shall be of a single manufacturer. Multiple manufacturers of the same equipment or item are not acceptable.
- C. Comply with California Electric Code (CEC), NFPA 70.
- D. American made products have been acceptable to the University. If non-domestic products are submitted, notice is hereby given that extensive testing shall be required to insure quality and conformance to the Specifications. Testing shall be done by a recognized lab acceptable to the University and all tests shall be witnessed by University personnel. All testing procedures and test results shall be satisfactory to the University.
- E. Contractor shall ensure that the manufacturer has minimum ten (10) years' experience in the manufacture of raceways and fittings similar to the type and size specified on this project.

- F. Manufacturer shall have ISO 9001 Certification.
- G. Products shall be new, modern in design, and manufactured within 12 months of installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- C. Sustainable Design Submittals:
 - 1. Product Data: For solvents and adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For solvents and adhesives, indicating compliance with requirements for low-emitting materials.
- D. Samples: For wireways and surface raceways and for each color and texture specified, 12 inches long. Sample for surface raceways for laboratories shall include outlets wired.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Tube & Conduit.
 2. Thomas & Betts Corporation, A Member of the ABB Group.
 3. Western Tube and Conduit Corporation.
 4. Wheatland Tube Company.
 5. Robroy Industries.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. EMT: Comply with ANSI C80.3 and UL 797.
- E. FMC: Comply with UL 1; zinc-coated steel.
- F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- G. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch, minimum.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: compression. Set Screw type not acceptable.
 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- I. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. RACO; Hubbell.
 2. Thomas & Betts Corporation, A Member of the ABB Group.

- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. ENT: Comply with NEMA TC 13 and UL 1653.
- D. RNC: Type 40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- E. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman; a Pentair company.
 - 3. Square D; a brand of Schneider Electric.
 - 4. Or equal.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type or Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Panduit Corp.
 - b. Wiremold / Legrand.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Erickson Electrical Equipment Company.
 - 2. Hubbell Incorporated.
 - 3. Milbank Manufacturing Co.
 - 4. RACO; Hubbell.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be NEMA 4X stainless steel and UL listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1 and UL 514A.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- I. Gangable boxes are allowed.
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 or Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- K. Exterior junction boxes shall be PVC coated GRC.
- L. Exterior Cabinets shall be Stainless Steel 316 or fiberglass reinforced plastic.

2.6 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by an independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 1. Exposed Conduit: All exterior conduit and conduit bodies shall be PVC Coated GRC.
 2. Concealed Conduit, Aboveground: GRC.
 3. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased for medium voltage.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R and Type 4.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: GRC.
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel or fiberglass reinforced plastic in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
 4. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
- E. Install surface raceways only where indicated on Drawings.
- F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

- G. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 1 inch of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Engineer for each specific location.
- J. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

- L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- S. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- V. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental

- temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
- X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.
- Y. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- Z. Locate boxes so that cover or plate will not span different building finishes.
- AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- 3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS
- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- 3.4 PROTECTION
- A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260544 SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

- F. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized sheet steel.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Advance Products & Systems, Inc.
 - b. Metraflex Company (The).
 - 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel.
 - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. HOLDRITE.
 - b. LINK SEAL.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 - 2. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with CEC 300.7(A)
- B. Comply with CEC 300.7(B)
- C. Comply with NECA 1.
- D. Comply with NEMA VE 2 for cable tray and cable penetrations.
- E. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.
- F. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.

2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- G. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- H. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- I. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.
- D. Delegated-Design Submittal: For arc-flash hazard study.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.

- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high letters on 20-inch centers.
- D. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pre-tensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- G. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 CONDUCTORS AND CABLES IDENTIFICATION MATERIALS

- A. Color coding of conductors: Provide color coded insulation by conductor manufacturer. Coordinate with Division 26, Section "Low Voltage Electrical Power Conductors and Cables". If permitted by University's Representative, install color coding conductor tape for temporary installations only.
- B. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels: Slit, pre-tensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- F. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- G. Provide tags on each pull rope of spare conduits showing starting point and end point of spare conduits.

2.3 FLOOR MARKING TAPE

- A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.4 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 2. 1/4-inch grommets in corners for mounting.
 3. Nominal size, 7 by 10 inches.
- D. Metal-Backed, Butyrate Warning Signs:
1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
 2. 1/4-inch grommets in corners for mounting.
 3. Nominal size, 10 by 14 inches.
- E. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES." for electrical service 600V or less.
 3. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 60 INCHES for electrical service above 600V and upto 15000V."
 4. High Voltage Equipment Warning "DANGER - HIGH VOLTAGE - KEEP OUT".
 5. Provide other warning labels and signs as required by applicable code and regulation.

2.5 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
1. Engraved legend with black letters on white face
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.6 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- B. Stenciled Legend: Provide stenciled labels to identify major equipment numbers (e.g. transformers, MV switches etc) indicated on drawings, in nonfading, waterproof, black ink or paint. Minimum letter height shall be 2 inch. Verify letter height with University's

Representative prior to start of work. Stencil labels shall be provided in addition to engraved laminated labels specified in paragraph 'A' above.

- C. Labels shall include the following information. Color of nameplate shall be black for equipment connected to normal power, red for equipment connected to emergency power, and blue for equipment connected to Un-Interruptible Power Supply. Color of letters shall be white.
 - 1. Panel or equipment designation.
 - 2. Rating: Volt, Amps, No. of phase and wires, Horsepower, etc.
 - 3. AIC Rating (RMS Symmetrical Amps).
 - 4. Fed from information.
 - 5. Manufacturer Shop Order number.
 - 6. Date of Installation.
 - 7. Other information as requested by University.
- D. Adhesive labels and nameplates are not acceptable.

2.7 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device. Use only where permitted.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Cable Ties: For attaching tags use general-purpose type, except outdoors, use UV-stabilized nylon.
- J. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at 10-foot maximum intervals.
- B. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label bands. Install labels at 10-foot maximum intervals.
 - 1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded service, feeders and branch-circuit conductors.
 - a. Color shall be factory applied or field applied with written permission from University's Representative.

- b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral : White
 - 5) Ground Green
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral : Grey
 - 5) Ground : Green
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- C. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use Laminated Micrata type, 5" x 3½", nameplates engraved with 5/32-inch high black letters on white background for normal power and red letters on white background for emergency power. Include the circuit designation to match University's existing standard. Verify with University's Representative prior to making labels.
- D. Install instructional sign including color code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.
- F. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive, self-laminating polyester labels with the conductor designation.
- G. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
- 1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

2. During backfilling of trenches install continuous underground-line warning tape directly above the line at 12 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- J. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- L. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer, load shedding.
- M. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification. Verify requirements with University's Representative.
 1. Labeling Instructions:
 - a. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - c. Fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure. Unless otherwise indicated, provide a single line of text 1-1/2 inch high label; where 2 lines of text are required, use labels minimum 2 inches high. Nameplates for switches, switchboards, transformers, distribution boards, panelboards shall be minimum of 2 inch high by 4 inch wide.
 2. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panel board manufacturer. Panelboard identification shall be engraved laminated acrylic label.
 - b. Enclosures, electrical, telecom, alarm and communication system cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.
 - f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panel boards or equipment supplied by the secondary. For pad-mount transformers- indicate type and size of fuses on a separate 3" X 5" plastic laminated label and install on the inside surface of the door of the transformer.
 - g. Substations.
 - h. Remote-controlled switches, dimmer modules, and control devices.
 - i. Monitoring and control equipment.

- j. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
- k. Emergency power system boxes and enclosures.
- l. Motor-control centers.
- m. Enclosed switches including ATS.

END OF SECTION 260553

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SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment for normal and emergency/standby power systems shown on the drawings.

1.2 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.3 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form and include a print copy in a binder.
 - 1. Arc-flash study input data, including completed computer program input data sheets.
 - 2. Arc-flash study report; signed, dated, and sealed by a qualified California registered professional engineer.
 - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from University Representative for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Arc-Flash Study Software Developer, Arc-Flash Study Specialist and Field Testing and Adjusting Agency.
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
- B. Operation and Maintenance Procedures: In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," provide maintenance procedures for use by University's personnel that comply with requirements in NFPA 70E.

1.6 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed and registered in California. The study specialist shall have at least 10 years' experience in performing arc flash study for facilities of similar size and scope. The specialist shall be located within 75 miles' radius of the project and available to meet on short notice. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- D. Testing and Adjusting Agency
 - 1. Field Testing and Adjusting Agency Qualifications: Testing and adjusting agency shall be an independent company; with the experience and capability to test and adjust overcurrent protective devices as indicated. The agency shall have been a member of NETA for a minimum of last ten (10) years and has permanent in-house testing engineers and technicians involved with testing and adjusting of overcurrent protective devices similar to those specified on this project.
 - 2. Testing and adjusting company shall be located with 50 miles radius of the project.
 - 3. Testing and Adjusting Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

4. Field Testing and adjusting technician and supervisor shall have minimum ten (10) years' experience in field testing and adjusting of Overcurrent Protective Devices of the type and rating similar to those devices to be tested on this project.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Software Developers:
 1. ETAP
 2. Comply with IEEE 1584 and NFPA 70E.
- B. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary.
- B. Study descriptions, purpose, basis and scope.
- C. One-line diagram, showing the following:
 1. Protective device designations and ampere ratings for normal and emergency/standby power system devices.
 2. Cable size and lengths.
 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 4. Motor and generator designations and kVA ratings.
 5. Switchgear, switchboard, motor-control center and panelboard designations.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output: As specified in "Short Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 26 05 72 "Overcurrent Protective Device Short-Circuit Study."
- F. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 26 05 73 "Overcurrent Protective Device Coordination Study."
- G. Arc-Flash Study Output:
 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.

- d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2, 3, 5, and 8 cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2, 3, 5, and 8 cycle circuit breakers rated on a total basis.
- H. Incident Energy and Flash Protection Boundary Calculations:
 - 1. Arcing fault magnitude.
 - 2. Protective device clearing time.
 - 3. Duration of arc.
 - 4. Arc-flash boundary.
 - 5. Working distance.
 - 6. Incident energy.
 - 7. Hazard risk category.
 - 8. Recommendations for arc-flash energy reduction.
- I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems." Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.
- B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 - 1. Location designation.
 - 2. Nominal voltage.
 - 3. Flash protection boundary.
 - 4. Hazard risk category.
 - 5. Incident energy.
 - 6. Working distance.
 - 7. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.
- D. Labels shall be suitable for indoor or outdoor environments for a minimum period of 5 years.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies:
 - 1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 26 05 72 "Overcurrent Protective Device Short-Circuit Study."
 - 2. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 26 05 73 "Overcurrent Protective Device Coordination Study."
- C. Calculate maximum and minimum contributions of fault-current size.
 - 1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
 - 2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.
- F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond three to five cycles.
 - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
 2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.
1. Verify completeness of data supplied on the one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to the attention of University Representative.
 2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
1. Product Data for overcurrent protective devices shown and specified in other Sections of this specifications. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 2. Obtain electrical power utility impedance at the service.
 3. Power sources and ties.
 4. Short-circuit current at each system bus, three phase and line-to-ground.
 5. Full-load current of all loads.
 6. Voltage level at each bus.
 7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
 8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
 9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
 10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
 12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
 13. Motor horsepower and NEMA MG 1 code letter designation.
 14. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

15. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.4 LABELING

- A. Apply one arc-flash label for above 600VAC, 600V ac, 480V ac, and applicable 208V ac equipment including each of the following locations:
 1. Motor-control center.
 2. Low-voltage switchboard.
 3. Switchgear.
 4. Medium-voltage switch.
 5. Panelboards
 6. Motor controllers including VFDs
 7. Disconnects
 8. Control panel.

3.5 APPLICATION OF WARNING LABELS

- A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.6 DEMONSTRATION

- A. Engage the Arc-Flash Study Specialist to train University's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 260574

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SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
 - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
 - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details.
 - 2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.

3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include evidence of UL listing for SPD as installed in distribution board and panelboard.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in distribution board and panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.
11. Wiring Diagrams: Submit wiring diagrams detailing power, signal, and control systems, clearly differentiating between manufacturer-installed wiring and field-installed wiring, and between components provided by the manufacturer and those provided by others.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01783 "Operation and Maintenance Data," include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Keys: Two spares for each type of panelboard cabinet lock.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

- B. Source Limitations: Obtain distribution boards and panelboards, overcurrent protective devices and accessories through one source from a single manufacturer through a local distributor unless otherwise indicated. All power distribution equipment shall be of the same manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 FIELD CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Construction Manager and University no fewer than 14 days in advance of proposed interruption of electric service.
 - 2. Notify Construction Manager and University no fewer than 30 days in advance of proposed interruption of electric service that require shut downs that last multiple days, and require shut down of buildings other than the Chiller Plant.
 - 3. Do not proceed with interruption of electric service without Construction Manager's and Owner's written permission.
 - 4. Comply with NFPA 70E.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
 - 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548 Electrical System Vibration Isolation and Seismic Restraints.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.
- F. Enclosures: Surface-mounted, dead-front cabinets with 2500 hour salt spray test.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R
 - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4
 - d. Indoor Locations Subject to Dust, Falling Dirt, and Corrosive Liquids: NEMA 250, Type 12.
 - 2. Finishes:
 - a. All steel parts shall be cleaned and zinc-phosphate pre-treatment applied prior to paint application.
 - b. Paint color shall be ANSI-61; TGIC polyester powder, applied electrostatically through air. Following paint application, parts shall be baked to produce a hard durable finish. The average thickness of the paint film shall be 2.0 mils. Paint film shall be uniform in color and free from blisters, sags, flaking and peeling.
 - c. Adequacy of paint finish to inhibit the build up of rust on ferrous metal materials shall be tested and evaluated per paragraphs 5.2.8.1-7 of ANSI C37.20.2 Salt spray withstand tests in accordance with ASTM Test Method B117 shall be performed on a periodic basis at the factory to provide conformance with the corrosion resistance standard of at least 2500 hours minimum.
 - 3. Incoming Mains:
 - 4. Location: Convertible between top and bottom.
 - 5. Main Breaker: Main bus interiors up to 400 amperes shall be field convertible to main breaker.
- G. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
 - 2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
 - 3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
- H. Conductor Connectors: Suitable for use with conductor material and sizes.
 1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Terminations shall allow use of 75 deg C rated conductors without derating.
 3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
 4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
- I. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
 1. Percentage of Future Space Capacity: Per drawings.
- J. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
 1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2.3 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Siemens Energy.
 2. Square D; by Schneider Electric.
 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Mains: as indicated on drawings.

- D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger than 125 A: Bolt-on circuit breakers.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Siemens Energy.
 - 2. Square D; by Schneider Electric.
 - 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: as indicated on drawings.
- D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Siemens Energy.
 - 2. Square D; by Schneider Electric.
 - 3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
- B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
 - 1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
 - 2. Fused Switch Features and Accessories:
 - a. Standard ampere ratings and number of poles.
 - b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks

- C. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers for frame size up to 250A:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic Trip Circuit Breakers for frame size 400A and above.
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
 - f. Integral test jack for connection to portable test set or laptop computer.
 - g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.
 1. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip). Provide in compliance with CEC requirements and indicated on drawings
 2. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
 3. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration. Provide in compliance with CEC requirements and indicated on drawings
 4. Subfeed Circuit Breakers: Vertically mounted.
 5. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.
 - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 - h. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
 - i. Auxiliary Contacts: Two, SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

- k. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
- l. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.

- C. Install panelboards and accessories according to NECA 407.
- D. Equipment Mounting:
 - 1. Attach panelboard to the vertical finished or structural surface behind the panelboard.
 - 2. Comply with requirements for seismic control devices specified in Section 260548 Electrical System Vibration Isolation and Seismic Restraints.
 - 3. Comply with mounting and anchoring requirements specified in Section 260548 Electrical System Vibration Isolation and Seismic Restraints.
- E. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- F. Mount panelboard cabinet plumb and rigid without distortion of box.
- G. Mounting panelboards with space behind is recommended for damp, wet, or dirty locations. The steel slotted supports in the following paragraph provide an even mounting surface and the recommended space behind to prevent moisture or dirt collection.
- H. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
 - 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- I. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- J. Install filler plates in unused spaces.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Perform optional tests. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
 - 1. Measure loads during period of normal facility operations.
 - 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
 - 4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262713 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes equipment for electricity metering by University.

1.3 DEFINITIONS

- A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.
- B. PC: Personal computer.

1.4 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical data for each type of product indicated.
- B. Shop Drawings: For electricity-metering equipment.
 - 1. Dimensioned plans and sections or elevation layouts.
 - 2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.
- C. Manufacturer Seismic Qualification Certification for Electricity-Metering Equipment: Submit certification that equipment components and their mounting and anchorage provisions have been designed to remain in place without separation of any parts or loosening of factory-made connections when subjected to the seismic forces and shall include the following:
 - 1. Basis for Certification: Indicate whether certification is based on actual test of assembled components or on calculations.
 - 2. Detailed description of equipment mounting and anchorage devices on which the certification is based and their installation requirements.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data. include the following:
 - 1. Application and operating software documentation.
 - 2. Software licenses.
 - 3. Software service agreement.
 - 4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in NFPA 70 and marked for intended location and application.
- B. Owner's Meters in switchgear/switchboard/distribution board shall be installed by the manufacturer at the factory.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, store, and handle modular meter center according to NECA 400.

1.9 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted in writing under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify University no fewer than fourteen (14) days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without University's written permission.
 - 3. Comply with NFPA 70E.
 - 4. Provide temporary standby power through a standby diesel quiet type back-up generator complete with fuel and 7/24 monitoring if the existing service interruption exceeds 2 hours. Coordinate additional requirements with owner minimum fourteen days in advance. Indicate method of providing temporary electric service.

1.10 COORDINATION

- A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:
 - 1. Comply with requirements of utilities providing electrical power services.
 - 2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

1.11 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years from the date of acceptance of the project by the owner.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software at no additional cost to the owner.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade his computer equipment if necessary.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY OWNER

- A. Manufacturers: Meter to be provided by College's Control vendor in accordance with campus standards and to be installed and integrated by the contractor. Refer to section 230900 DDC Controls for meter information.
- B. General Requirements for Owner's Meters:
 - 1. Comply with UL 1244.
 - 2. Meters used for billing shall have an accuracy of 0.5 percent of reading, complying with requirements in ANSI C12.20.
 - 3. Meters shall be certified by California Type Evaluation Program as complying with Title 4, California Code of Regulations, Article 2.2
 - 4. Enclosure: NEMA 250, Type 1 minimum, with hasp for padlocking or sealing.
 - 5. Meters installed outdoor shall be in NEMA 3R enclosure. Meter in enclosure shall be factory installed and assembled with strip heaters controlled by thermostat.
 - 6. Identification: Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 7. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
 - 8. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.
 - a. Type: Split and solid core.

9. Current-Transformer Cabinet: Listed or recommended by metering equipment manufacturer for use with sensors indicated.
 10. Building Automation System (BAS) Interface: One digital KY pulse to a user-definable increment of energy measurement. Match signal to BAS input and arrange to convey the instantaneous, integrated, demand level measured by meter to provide data for processing and possible programmed demand control action by destination system.
- C. Kilowatt-hour Meter: Electronic three-phase meters, measuring electricity used.
1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
 2. Display: LCD with characters not less than 0.25 inch (6 mm) high, indicating accumulative kilowatt-hours and current kilowatt load. Retain accumulated kilowatt-hour in a nonvolatile memory, until reset.
 3. Display: Digital electromechanical counter, indicating accumulative kilowatt-hours.
- D. Kilowatt-hour/Demand Meter: Electronic single- and three phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.
1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.
 2. Display: LCD with characters not less than 0.25 inch (6 mm) high, indicating accumulative kilowatt-hours, current time and date, current demand, and historic peak demand and time and date of historic peak demand. Retain accumulated kilowatt-hour and historic peak demand in a nonvolatile memory, until reset.
- E. Data Transmission Cable: Transmit KY pulse data over Class 1 control-circuit conductors in raceway. Comply with Section 260523 "Control-Voltage Electrical Power Cables."
- F. Software: PC based, a product of meter manufacturer, suitable for calculation of utility cost allocation and billing.
1. Utility Cost Allocation: Automatically import energy-usage records to allocate energy costs
 2. Tenant or Activity Billing Software: Automatically import energy-usage records to automatically compute and prepare activity demand and energy-use statements based on metering of energy use and peak demand. Maintain separate directory for each tenant's historical billing information. Prepare summary reports in user-defined formats and time intervals.
 3. Accessories:
 - a. Fuses: Provide fuses to protect meters.
 - b. Shunting Devices: Provide shunting devices for maintenance of meters.
- G. Accessories:
1. Fuses: Provide fuses to protect meters.
 2. Shunting Devices: Provide shunting devices for maintenance of meters.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.
- C. Install modular meter center according to NECA 400 switchboard installation requirements.

3.2 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.
 - 2. Equipment Identification Labels: Adhesive film labels with clear protective overlay. For residential meters, provide an additional card holder suitable for printed, weather-resistant card with occupant's name.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
 - 2. Turn off circuits supplied by metered feeder and secure them in off condition.
 - 3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
 - 4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results. This shall be done in the presence of Owner's Meter Shop Personnel. Coordinate through Owner's Representative.
- C. Electricity metering will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 262713

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Weather-resistant receptacles.
 - 3. Snap switches
 - 4. Wall-switch
 - 5. Wall Plates.
 - 6. Finishes
 - 7. Indoor ceiling mounted occ. Sensor
 - 8. Wall Box mounted occ. Sensor

1.3 DEFINITIONS

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

1.4 ADMINISTRATIVE REQUIREMENTS

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

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
 - 2. Hubbell Incorporated; Wiring Device-Kellems.
 - 3. Leviton Manufacturing Co., Inc.
 - 4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.

- d. Pass & Seymour/Legrand (Pass & Seymour).

2.4 GFCI RECEPTACLES

- A. General Description:
 - 1. Straight blade, feed-through type.
 - 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
 - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Wiring Devices, Inc.; Division of Cooper Industries, Inc.
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).

2.5 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Single Pole:
 - 1) Cooper; AH1221.
 - 2) Hubbell; HBL1221.
 - 3) Leviton; 1221-2.
 - 4) Pass & Seymour; CSB20AC1.
 - b. Three Way:
 - 1) Cooper; AH1223.
 - 2) Hubbell; HBL1223.
 - 3) Leviton; 1223-2.
 - 4) Pass & Seymour; CSB20AC3.

2.6 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: 0.035-inch- thick, satin-finished, Type 302 stainless steel.
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.7 FINISHES

- A. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: Stainless Steel unless otherwise indicated or required by NFPA 70 or device listing.

2.8 EXECUTION

2.8 INSTALLATION

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

4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

2.9 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

2.10 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar

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

- C. Wiring device will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, ballasts, and drivers.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.
5. Retrofit kits for fluorescent lighting fixtures.

B. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.2 REFERENCES

- A. ANSI/NFPA 70, National Electrical Code
- B. IESNA LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products
- C. IESNA LM-80, Approved Method for Measuring Lumen Maintenance of LED Light Sources
- D. IESNA TM-21, Luminaire Classification System for Indoor Luminaires
- E. UL1598, Standard for Safety of Luminaires

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, and finishes.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Luminaires shall be fully assembled and individually electrically tested prior to shipment.
- D. Manufacturers of LED luminaires shall demonstrate a suitable testing program to ensure system reliability and to substantiate lifetime claims.
- E. The sole use of IESNA LM-80 data to predict luminaire lifetime is not acceptable.
- F. At time of manufacture, electrical and light technical properties shall be recorded for each luminaire. At a minimum, this should include lumen output, CCT, and CRI. Each luminaire shall utilize a unique serial numbering scheme. Technical properties must be made available for a minimum of 5 years after the date of manufacture.
- G. Luminaires shall be provided with a minimum 5 year warranty covering, LEDs, drivers and paint finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Metal Parts: Free of burrs and sharp corners and edges.
- C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- E. Diffusers and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

- a. Lens Thickness: At least [0.125 inch (3.175 mm)] minimum unless otherwise indicated.
 - b. UV stabilized.
2. Glass: Annealed crystal glass unless otherwise indicated.

2.3 DRIVERS FOR LED FIXTURES

- A. Electronic Driver for LED Fixtures: Comply with UL 1310 Class 2 requirements for dry and damp locations. Include the following features unless otherwise indicated:
 1. Rated for 50,000 hours of life, unless otherwise noted.
 2. Sound Rating: Class A.
 3. Total Harmonic Distortion Rating: 15 percent or less.
 4. Current Crest Factor: 1.5 or less.
 5. 0-10V Dimming Standard (Step Dimming does not qualify)

2.4 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 1. Lamps for AC Operation: Fluorescent, two for each fixture, 20,000 hours of rated lamp life.
 2. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
 3. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.5 EMERGENCY LIGHTING UNITS

- A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.
 1. Battery: Sealed, maintenance-free, lead-acid type.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay

- disconnects lamps from battery, and battery is automatically recharged and floated on charger.
- 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
- 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
- 6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
- 7. Integral Time-Delay Relay: Holds unit on for fixed interval of [15] <Insert period> minutes when power is restored after an outage.

2.6 LED FIXTURES

- A. provide LED luminaires, of types and sizes indicated on fixture schedules.
- B. Include the following features unless otherwise indicated:
 - 1. Each Luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply).
 - 2. Each luminaire shall be rated for a minimum operational life of 50,000 hours utilizing a minimum ambient temperature of (25°C).
 - 3. Light Emitting Diodes tested under LM-80 Standards for a minimum of 12,000 hours.
 - 4. Color Rendering Index (CRI) of 82 at a minimum.
 - 5. Color temperature 4000K, unless otherwise indicated.
 - 6. Rated lumen maintenance at 70% lumen output for 50,000 hours, unless otherwise indicated.
 - 7. Fixture efficacy of 60 Lumens/Watt, minimum.
 - 8. 5 year luminaire warranty, minimum.
 - 9. Photometry must comply with IESNA LM-79.
 - 10. The individual LEDs shall be constructed such that a catastrophic loss of the failure of one LED will not result in the loss of the entire luminaire.
 - 11. Luminaire shall be constructed such that LED modules may be replaced or repaired without the replacement of the whole fixture.
- C. Technical Requirements
 - 1. Luminaire shall have a minimum efficacy of 60 lumens per watt. The luminaire shall not consume power in the off state.
 - 2. Operation Voltage: The luminaire shall operate from a 50 HZ to 60 HZ AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.
 - 3. Power Factor: The luminaire shall have a power factor of 0.9 or greater.
 - 4. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 15 percent.
 - 5. Operational Performance: The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.
- D. Thermal Management
 - 1. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.

2. The LED manufacturer's maximum thermal pad temperature for the expected life shall not be exceeded.
3. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.
4. The luminaire shall have a minimum heat sink surface such that LED manufacturer's maximum junction temperature is not exceeded at maximum rated ambient temperature.

2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Comply with NFPA 70 for minimum fixture supports.
- C. Suspended Lighting Fixture Support:
 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265100